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THE AMERICAN
JOURNAL OF PHARMACY

VOL. 97. OCTOBER, 1925. NO. 10.

# EDITORIAL

## THEY KNEW.

There is printed elsewhere in this issue a tentative draft of the findings of the Educational Research Committee of the Commonwealth Fund, which under the brilliant directorship of Dr. W. W. Charters, has about completed its answer to the question "What Should a Pharmacist Know?"

Judged from any viewpoint the work of Dr. Charters and his assistants has been conducted with consummate skill and completeness. True that some avenues of investigation have been ignored, but they were neglected only because they were not definite parts of the great purpose. Such side issues were wisely passed by, and if it becomes necessary ever to return to them, they are on record and will not be difficult to find.

The final report of Dr. Charters will not be greatly different from the tentative draft submitted. The general conclusions are bound to remain unchanged, and the nature of them must bring to the heart of every real pharmacist much pride and more encouragement. To have a person, entirely removed from pharmacy, and so widely recognized for his research ability, as the director of this investigation, was a most satisfactory occurrence; but to have this person, without bias or prejudice, draw the conclusions presented in his report, is the most promising and encouraging thing that has come into modern pharmacy.

But it will not derogate Dr. Charters' work in the least, to remark that there were some who had long since anticipated many of his conclusions and who had the vision to look ahead and the courage to plan ahead, long before this study was ever undertaken.

These men had kept faith in their work in spite of handicaps, in spite of criticism, in spite of failures. *They* had been well aware of

the heavy barrage of criticism which had long hung over the practice of pharmacy—that it had been over-commercialized, and sunk to the level of soda fountain dispensing and rule of thumb storekeeping—that it usurped the functions of the doctor by counter-prescribing—that it was pseudo-scientific without an intelligent grasp of the sciences it pretended to utilize, and that in its effort to commercialize the occupation every vestige of its ancient professional morale had been lost. *They* had also listened to these unhealthy criticisms, and some they knew to be true. But *they* did not heed discouragement.

Quietly *they* had gone ahead with their purpose. *They,* also, had made it their definite business to know "just what the pharmacist does, what place he fills in society, how much he needs to know and what sort of training shall be given him, that he may properly and intelligently fulfill his functions."

And *they* knew that "Pharmacy *is* a Profession—not a Trade," and that "the well-informed pharmacist *is* the best single individual to disseminate information about public health."

To that end and for that reason it had been their long-established custom to adequately train young men and women so that they might acquire a "wide and intimate acquaintance with the fundamental sciences upon which their art depends."

Through the troublous years of the past decade, when educational nihilists within the college laughed at "cultural" courses and even ventured to assail the old-established scheme of education, these men continued in the faith.

*They* knew the road—and held steady to their tasks of education. Preaching the code of ethics, revising the books of medicinal standards, researching in every scientific field, teaching and inspiring young people, holding aloft the banner of professional and ethical pharmacy, these men had indeed long anticipated the report of the Commonwealth Fund Committee. *They* receive it, now, as a welcome vindication and *they* are glad it so fully agrees with their judgment.

*They* are the educators in Pharmacy—everywhere—whose courage and vision and patience, have well earned for them the comfort and elation which the Charters' document must inevitably bring.

IVOR GRIFFITH.

# SELECTED EDITORIAL

## PHARMACY AND CULTURE.*

Like the humans who use them, words sometimes fall into bad company and lose caste. It was so with the name and idea of "Culture" in the Germanised guise of "Kultur." For in the militant apocalypse of Treitschke and Bernhardi the word "Kultur" was made the label of the fee-fo-fum doctrine and propaganda of Germanic world dominion by force of arms, and of the hellish policy of frightfulness in warfare. But culture in the time-honoured humanist sense has a nobility and beneficence that is inviolable and indestructible, because it means all that is highest and purest in civilisation at all levels from the most lowly to the most exalted. All the fairest and most fragrant flowers in the garden of the mind, and the richest and finest fruits in the fields in which the arts of life grow and flourish are the products of age-long culture which had its humble beginnings in the thought and labor of our early ancestors. With culture man is, at his best, still somewhat lower than the angels, and it is well that it should be so. Without culture in one degree or another, man is a savage beast. There is an erroneous notion abroad that culture is an accomplishment obtainable only by academic training. In short, that the man or woman of culture is one who has been through the mill at a historic public school or some ancient and renowned university, and who is hall-marked by certain peculiarities of pronunciation, accent, and general attitude of superiority and patronage towards the hosts of the Philistines who for them are for ever out of intellectual and cultural bounds. But these vanities, which to do the finer products of the system justice, are confined mostly to the baser sort of the academic class and cult. are a mere simulacrum of the reality, an affectation which, like hypocrisy, is an oblique tribute to the righteousness which it assumes, but has not. Just as among the camp followers of literature, music, and the fine arts, there are swarms of pretenders who, because it is the proper thing, or the fashion, make-believe to admire classic paintings which they really rank below the grocers' Christmas calendar picture; to worship Shakespeare when a silly spectacular revue is infinitely more to their taste, and to be enraptured by Wagner's operas when their real

*Reprinted from *Pharmaceutical Journal.*

passion is for the jazziest of jazz pandemonium. In other relations, too, much of what is accepted or passes for culture is not even a colorable imitation of it—but the counterfeit is the correlative of the genuine original, and it is with this that we are concerned.

Of the many proposed definitions of the man of true culture, perhaps the best is that it is he who knows everything about something and something about everything. According to this canon every specialist in whatever subject is, in large measure, a man of culture, although not a complete one, but in these times of the vast expansion of the empire of knowledge, there is no human being who in any tenable sense can claim, or is entitled to be described as knowing something about everything. Even the Admirable Crichton, were he to be reincarnated, would be unable to qualify according to this standard. There are many men of the world, clever conversationalists and "crack" public speakers with a veneer of culture which looks remarkably as if their make-up was of the solid substance, but just as if you scratch a Russian you come on a Tartar, so a very shallow incision of the mental cuticle of these apparent know-alls lets out the stuffing and shows the material to be spurious.

In pharmacy the substructure of the culture of the future pharmacist is laid by the form and subject-matter of the general education required of every entrant into the calling. This may be of Matriculation standard or considerably lower, and nowadays, unless in exceptional cases, the student of pharmacy who is father to the fully developed pharmacist, has had no Latin and little or no acquaintance with the classics. We are not convinced that the conventional public school methods of teaching Latin and Greek, even in their somewhat modernised adaptations, are calculated to make good Latin or Greek scholars. The acquisition of any language other than one's mother-tongue, the knowledge of which grows with our growth, is largely an exercise of memory, and when to this task there is added that of verse-making, for which few boys or girls have much natural aptitude, and the exhaustive grammatical and philological analysis of the text of the prescribed Latin or Greek author, it is inevitable that, save for the scholarly few, this process, instead of creating and fostering an ardent love of and lifelong devotion to classical culture, is apt to fill the pupil with an invincible dislike or positive loathing for the classical languages and literature. Even in the teaching of English literature has not our tedious and painful experience in dissecting with the grammatical scalpel such masterpieces as Mil-

ton's "Paradise Lost" and Gray's "Elegy," made them lastingly intolerable to us? For in the realm of mind the products of forced culture are often inferior in palatableness and other qualities, for the same reason that forced veal and vegetables are seldom equal to the naturally bred or cultivated product.

As the classics can no longer be counted upon as a normal element in the substructure of the general education of the pharmacist, and, therefore, as a formative and pervasive force in his cultural outfit, what is there to put in its place? Anyone can take a horse to the water, but no one can make him drink. If the twig is not bent in the sapling, the branch into which it grows in the tree cannot, without destructive force, be changed from its fixed inclination. Perhaps, however, in these times, when everybody reads—something, the most hopeful approach to the high road of culture, upon which so few travel, is by way of the study of literature--classical, historical, biographical, and general. There is a wide range of choice, so that all tastes may be suited. It is assumed that the student of pharmacy, or the pharmacist, who should never give off being a student, has made himself familiar with the standard works, which are really the tools of his trade, and that he keeps himself abreast of progress in his profession by scanning the pages of the periodical pharmaceutical press. Unless he does, he lacks culture as a specialist, and his business and professional standing and prestige may suffer. But he must not neglect general culture within such limits as are necessary to make him a reasonably well-informed man. It is always an advantage to be able to speak intelligently of the history and literature of the ancient and of the modern world. A sufficient knowledge of this can be acquired pleasantly from the standard histories, or abridgements of them, and from the many excellent translations of classical authors, such as Jowett's "Plato" and Professor Gilbert Murray's masterly English versions of the tragedies of Euripides. Standard fiction, English and foreign, also should be read, but if the habit of systematic reading is to be maintained, it must be formed in early life. Unless reading is done on a large scale in youth and early manhood it is difficult, even if there is the inclination for it, to find the necessary leisure amidst the pressure and distractions of business or public life. Reading, whilst one of the most important aids to culture, is not the only one. Intercourse with one's fellows, observation and experience of life at home or abroad, and other factors, all have, or may have their share in turning out the finished product,

if there ever can be such a consummation in a process that is never complete whilst life lasts. But under whatever conditions or by whatever means, it is pre-requisite that to the limit of his capacity and opportunity the pharmacist should be a man as well of general as of special culture. That is, if he or she is to attain and hold professional rank and reputation.

# ORIGINAL ARTICLES

## STUDIES IN THE GENUS MENTHA, VII.
### An Examination of an Oil of Mentha Piperita, L., Produced in 1922.[1]

By Roland E. Kremers.[2]

The classical examination of the oil of Mentha piperita, L., (Peppermint) is that of Power and Kleber.[3] They isolated and identified no less than seventeen substances. Painstaking as this investigation was, it still left an appreciable percentage of the oil unaccounted for, and did not satisfactorily explain all the differences in oils from different sources.

Since the ultimate purpose of the present studies is the elucidation of certain phenomena, presumably hereditary in nature, it is a matter of prime importance to know the exact composition of a particular strain of Mentha piperita oil and the limits of its seasonal variations.

*Material.*—The oil for the present investigation was derived from the strain of Mentha piperita, L., which has been grown for a number of years in the gardens of the Wisconsin Pharmaceutical Experiment Station. Grateful acknowledgment is made to Prof. W. O. Richtmann, who has the management of the gardens in his care, for placing the entire output of 1922 peppermint oil at the writer's disposal. Steam distillation of the herb gave nearly 5.4 liters of oil and approximately 1500 liters of aqueous distillate. The cohobation of the latter yielded an additional 640 grams of oil.

[1] Contribution from the Wisconsin Pharmaceutical Experiment Station, at Madison.

[2] National Research Council Fellow in Chemistry, 1922-1923.

[3] *Pharmazeutische Rundschau*, 12 (1894), 157.

*Characterization of the Oil.*—The following values were determined to characterize the oils:

| | *Cohobated Oil* | *Original Oil* |
|---|---|---|
| Acid number | 1.5 | 1.5 |
| Ester number | 28. | 23. |
| Ester no. after acetylization | 170. | 156. |
| Percent ester | 9.9 | 7.7 |
| Percent combined menthol | 7.9 | 6.6 |
| Percent total menthol | 54.2 | 49.5 |
| Percent free menthol | 46.3 | 42.9 |

**Examination of the Cohobated Oil.**

*Methyl-1 Cyclohexanone-3.*[4]—The first steps in the examination of the cohobated oil were the drying and careful fractionation. Then methyl-1 cyclohexanone-3 was sought for in the fractions boiling below 190° C. To this end, these fractions were reunited, freed of acid by sodium bicarbonate solution and then thoroughly extracted by saturated sodium bisulfite solution. No ketone was recovered by this procedure. The same material was then brought into contact with a solution of semicarbazide. No semicarbazone was obtained either directly from the reaction mixture, or after rectification of the oil by steam distillation. Obviously there was no ketone in the material boiling below 190° C.

*Terpene Fraction.*—After these negative results, attention was turned to the resolution of the terpenes. Digestion with metallic sodium converted the alcohols into alcoholates. The latter were involved in reaction with phthalic anhydride and the resulting acid esters were shaken out with dilute sodium hydroxide. Dilute sulfuric acid precipitated an oil from the alkaline aqueous solution. Hence the alcohols were recovered by saponification and steam distillation. A phenylurethane was obtained which melted at 108-09° C. after recrystallization from 70 per cent. ethanol. It was apparently a menthyl-phenylurethane; mixed melting point 109-11° C.

The oil thus freed of hydroxy compounds was distilled over sodium. Only a small amount was recovered boiling between 165° and 180° C. A reaction between nitrosyl-chloride and fraction 165-70° did not give a crystalline addition product.

[4] Compare with *Jour. Am. Pharm. Assn.*, 10 (1921), 836.

*High Boiling Ketone.*—Pulegone[5] was sought in the fractions just above the boiling range of menthol. Fractions 216-25° and 225°+ were each mixed with one-fourth of their volume of 30 per cent. sodium bisulfite solution. The mixtures were frequently agitated during two weeks. No reaction product separated. The two mixtures were united and the oily layer was separated from the aqueous. The latter was completely freed of oil by ether. Such bisulfite addition product as had formed remained in this solution and was decomposed by the addition of potassium hydroxide. The ketone was separated mechanically, washed, and steam distilled. A little more was obtained from the alkaline mother solution by steam distillation. Yield 7.5 g.

$$d_{25} = \text{about } 0.935; \qquad n_{25} = 1.4915.$$

The semicarbazone prepared in the usual way was very slightly soluble in ethanol. The substance was therefore purified by several extractions with this solvent at its boiling point. An initial fusion of this product took place at 214-15° C.; complete decomposition with evolution of gas was observed at 226-28° C.

The physical properties of this ketone correspond with those of a menthenone, and piperitone is the only isomer for which there has been recorded a semicarbazone melting above 200° C. Dr. C. Kleber, of Clifton, N. J., very generously sent the writer a specimen of piperitone prepared by himself from the oil of Eucalyptus dives. This courtesy is hereby gratefully acknowledged. The semicarbazone was readily obtained from the ketone. The melting points of these two semicarbazones as well as of their mixture were determined simultaneously in a Thiele tube. The primary fusion took place alike in all three at 215° C., total destruction ensued at a higher temperature.

*Menthol and Menthone.*—The oil which had been treated with sodium bisulfite was rectified with steam, saponified, again rectified with steam, dried and fractionated. The material distilled very largely within the range of a mixture of menthol and menthone. A considerable quantity of menthol was obtained by freezing out by exposure to winter temperatures. When isolation by this means was no longer profitable, a portion of the oil was treated with pyridine

[5] Compare with *Jour. Biol. Chem.*, 52 (1922), 443.

and benzoyl chloride. The resultant slightly volatile benzoic esters were isolated as a still residue by steam distillation. Although menthyl benzoic acid ester is said to crystallize readily, this material could not be brought into a crystalline state. A fractionation in vacuo revealed a wide boiling range, indicative of a mixture.

The presence of menthone was established by means of its characteristic semicarbazone, melting point 184-5° C.

## Examination of Peppermint Oil Proper.

The first step in the examination of the peppermint oil proper was to freeze out as much menthol as possible: 630 g. were separated in this way, or roughly one-eighth of the total. The oil was then repeatedly fractionated, partly at atmospheric pressure and partly in a vacuum. The fractions distilling below 195° C. were finally distilled several times over sodium to remove alcohols.

*Cineol.*—The cineol, which is not removed by sodium from the terpenes, was combined with resorcinol and the crystalline addition product removed by suction filtration. The cineol was regenerated and further purified through its hydrogen bromide addition product.

B.p. = 170-172° C.; $d_{22}$ = 0.9196; n = 1.4560; d = —0.45°. Cineolic acid, m.p. 206° C., was readily obtained.

*Terpenes.*—The oil freed from cineol was rectified and then repeatedly fractionated from sodium through a short Vigreux column. Since no conclusive results were obtained with this material, the following physical data are presented for the last series of fractions.

| *Frac.* | *B. p.* | *Vol.* | *d22* | *n22* | $\alpha_D$ |
|---|---|---|---|---|---|
| 1. | —158°C. | 10 ml. | 0.847 | 1.4595 | —3.9° |
| 2. | 158- 63 | 20 " | 0.843 | 1.4640 | —6.8 |
| 3. | 163- 68 | 45 " | 0.845 | 1.4675 | —17.2 |
| 4. | 168- 73 | 50 " | 0.846 | 1.4675 | —33.0 |
| 5. | 173- 78 | 20 " | 0.854 | 1.4690 | —41.7 |

Attempts to identify phellandrene in fractions 3 to 5 gave negative results.

Neither the hydrobromide nor the tetrabromide of limonene were obtainable from fraction 5.

All fractions gave a crystalline nitrosochloride addition product, but in varying quantity. That from fraction 1 melted at 108-9° C.; from fraction 5, between 105-10° C. However, no benzylamine

base was obtainable. In each case benzaldehyde was formed as evidenced by its characteristic odor. The uniformly high melting points of the nitrosoclorides and their abnormal behavior with benzylamine suggest the presence of a terpene other than pinene or limonene.

*Menthol.*—Assays indicate that rectified American peppermint oil contains fifty or more per cent. of alcohols calculated as *l*-menthol. Yet it is well known that the removal of any appreciable portion of this menthol by "freezing out" processes is ordinarily a matter of considerable difficulty. The problem of bringing this menthol to crystallization, or conversely the discovery of the cause for its not crystallizing readily, was approached through:

1. Careful fractionation,
2. Treatment with sulfite and bisulfite,
3. Treatment with phthalic anhydride and benzoyl chloride.
4. Treatment with hydroxylamine.

The summaries of these operations follow.

1. *Fractionation.*—950 ml. of oil distilling between 90 and 125° C. at 20 mm. pressure after the preliminary treatment described at the beginning of this paper were repeatedly and carefully fractionated. A 12-inch Vigreux column was used. The result was the following series:

| *Frac.* | *B. p. 18 mm.* | *Vol.* | *d22* | *n22* | *α22* |
|---|---|---|---|---|---|
| 1. | —85°C. | 51 ml. | 0.987 | 1.4650 | —2.50° |
| 2. | 85-95 | 86 " | 0.911 | 1.4645 | +17.50 |
| 3. | 95-99 | 135 " | 0.920 | 1.4622 | +19.75 |
| 4. | 99-02 | 92 " | 0.908 | 1.4595 | +0.00 |
| 5. | 102-05 | 51 " | 0.902 | 1.4585 | —15.75 |
| 6. | 105-08 | 135 " | 0.896 | 1.4590 | —24.25 |
| 7. | 108-11 | 220 " | 0.909 | 1.4615 | —34.00 |
| 8. | 111-20 | 52 " | 0.912 | 1.4660 | —26.75 |
| 9. | 120 | 80 " | residue. | | |
| | | 48 loss. | | | |

Although it was evident from these data that a considerably greater separation of constituents had taken place, the crystallization of menthol had not been made much easier.

*2. Treatment With Sulfites.*—A quantity of oil similar to that used in the above fractionation was treated with sodium bisulfite solution. No separation of substances was effected. The fractions obtained in 1 were assayed by the neutral sulfite method. Fractions 2 and 3 each showed 8 per cent. and fraction 8 showed 22 per cent. by volume loss. Intermediate fractions showed a smaller loss.

Accordingly fractions 2 to 5 inclusive, together with other similar fractions, and fraction 8 and its analogues were digested with sodium sulfite in the manner prescribed for the assay. The regenerated ketones were characterized separately.

The ketone from the fractions boiling below 105° C. at 18 mm. had the following properties:

b.p. = 215-21° C.; d22 = 0.922; n = 1.488; $a_D$ = + 17.7°; $a_D$ = + 18.1°; M.R. = 47.4; calculated for a menthenone 45.56.

The semicarbazone recrystallized twice from 70 per cent. ethanol melted between 171-72° C. Very little of the crude product was insoluble in hot ethanol.

The ketone from the fractions boiling above 111° C. had the following properties:

b.p. = 222-30° C.; $d_{22}$ = 0.9324; n = 1.4850; $a_D$ = + 9.05°; $a_D$ = + 9.70; M.R. = 46.6.

Semicarbazone: the fraction insoluble in hot 95 per cent. ethanol decomposed at 235° C.; the fraction recrystallized from this solvent melted at 215° C. The oxyamino-oxime melted at 164-5° C. An oxyamino-oxime prepared from *l*-piperitone melted [6] at 164-5° C.; the mixed melting point was found at 163-4° C.

*3. Treatment With Phthalic Anhydride and With Benzoyl Chloride.*—A quantity of oil from fractions rich in menthol was heated with phthalic anhydride and maintained at 120-30° C. The uncombined oil was recovered by steam distillation. The residual esters were saponified with sodium hydroxide and the liberated alcohols were isolated by steam distillation. The latter were found to distill between 200 and 215° C.; the menthol fraction was the largest, but even it did not crystallize spontaneously. However, it was found possible to obtain a quantity of crystalline menthol by repeated alternate freezing out and refractionating.

[6] The specimen of *l*-piperitone used in this preparation was very generously given by Dr. A. R. Penfold, of the Technological Museum, Sidney, Australia. The writer is glad to acknowledge his indebtedness to Dr. Penfold.

In one experiment on the separation of menthol through the benzoic acid ester, a crystalline product resulted. 100 g. of oil boiling between 105 and 111° C. at 18 mm. were treated with benzoyl chloride and pyridine. The benzoic esters did not crystallize even after prolonged treatment with steam, which removed 40 g. of oil. Crystallization from solvents was not attempted. Saponification was accomplished by alcoholic KOH and the terpene alcohols were recovered by the addition of water. The oil was dried over sodium sulfate and fractionated. B.P. 40 mm. = 122-125° C. The distillate crystallized after inoculation. Yield 30 g. M.P. 30° C. Ordinary *l*-menthol melts at 42.5° C.

It may be mentioned that with both the phthalic anyhydride and the benzoyl chloride reactions, a considerable loss of material took place which remains unexplained.

*4. Treatment With Hydroxylamine.*—Experiments based on the formation of menthonoxime as a means of purifying the menthol fractions did not lead to decisive results.

## Summary.

1. The foregoing studies of the American peppermint oil produced at the Wisconsin Pharmaceutical Experiment Station Gardens in the summer of 1922 have not settled either the entire composition of the oil or the reasons for the difficulty in the crystallization of menthol.

2. The previously well known constituents cineol, *l*-menthol, and *l*-menthone were identified.

3. Neither methyl-*l* cyclohexanone-3 nor pulegone were found in the cohobated oil of this year.

4. Neither pinene nor phellandrene nor limonene, which have been previously reported, was definitely characterized. The possibility of another terpene being present in the mixture of low boiling substances is worth considering.

5. d-Piperitone was identified in both the cohobated and primary oils. A menthenone closely resembling pulegone was found in the primary oil.

6. Although no conclusive evidence was obtained, the indications were that other alcohols than *l*-menthol were present in the menthol-menthone fractions and were the principal cause for the non-crystallization of *l*-menthol from high concentrations.

# "SOME SIDELIGHTS ON PHARMACY IN PEKING, CHINA."

**By John Cameron, M. P. S.**

**Department of Pharmacy, Peking Union Medical College, Peking, China.**

The city of Peking offers perhaps what is one of the most striking contrasts in pharmaceutical service of any city in the world today. There are five different—totally different—forms of drug stores operating in this city and it occurred to the writer that a few notes on these establishments might prove of more than passing interest to brother pharmacists throughout the United States.

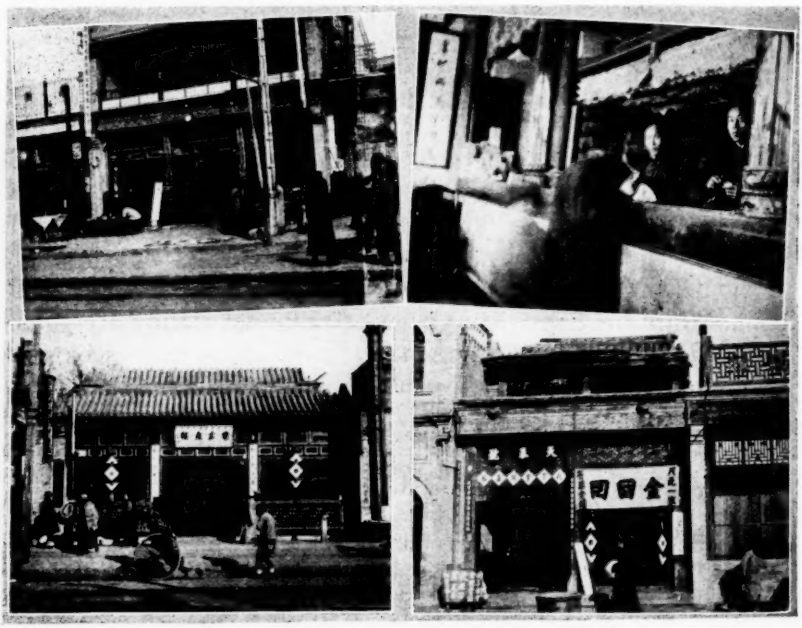
The following are the five different groups of drug stores which are common to nearly all Chinese cities—especially to the better known seaport towns: Shanghai, Tientsin, Tsingtao, etc.

A. Old fashioned Chinese drug stores.
B. Small drug stalls at markets.
C. New patent medicine shops.
D. Chinese owned modern pharmacies.
E. Foreign owned modern pharmacies.

In almost every village of this vast republic one may find at least one old fashioned Chinese drug shop—and in Peking there are hundreds of them. They are all very much alike—in fact they all seem to have been built on the same plan. They are easily recognized by their special drug store sign—a plaster and two half plasters suspended on a chain and usually to be found hanging on either side of the entrance doorway.

On entering the drug store one sees a very high serving counter, behind which there may be as many as twenty or twenty-five youthful assistants all anxious to attend to the wants of customers. Behind these assistants there are endless rows of small drawers containing all manner of herbs, roots, nuts, dried fruits, leaves, etc., and above these drawers one may see a couple of rows of blue porcelain jars with brass tops. These jars contain pills and special preparations of the drug store. The pills are most unusual and are worthy of special mention—they vary in size—some being as large as a walnut, and they are usually coated with white wax. Each drug store prepares its own special pills, which are known to the public as specifics in special complaints, and sometimes people travel many miles in order to purchase them. These pills are sometimes very expensive; the writer has known of instances where gold, $15, has been charged for one pill. During the month of March, 1925,

the writer has had occasion to visit more than fifty old Chinese drug stores in Peking and perhaps what impresses one most is the dark and dismal appearance of the interior of the shop. It was rather surprising to be told that the number of assistants in the larger and more prosperous establishments was usually more than fifty. In one case the proprietor said that they numbered eighty-five. Before discussing the personnel of the drug store let us take a look behind the scenes. Immediately behind the front shop there is a large room where the proprietor is usually to be found. In this room most of the official business of the drug store is transacted—special friends may be entertained, samples of crude drugs may be brought here and examined by the chief assistant and the price decided on over a cup of Chinese tea. Old prescriptions and formulæ are usually preserved in this sanctum. This room usually opens out into a fairly large courtyard, one side of which is given up to the storage of poisons *nux vomica,* croton seed, etc. It is interesting to note



(Upper Left.) An old Chinese drug store in Peking—the drug store sign can be seen above the white notice board at the left-hand side of the entrance door.

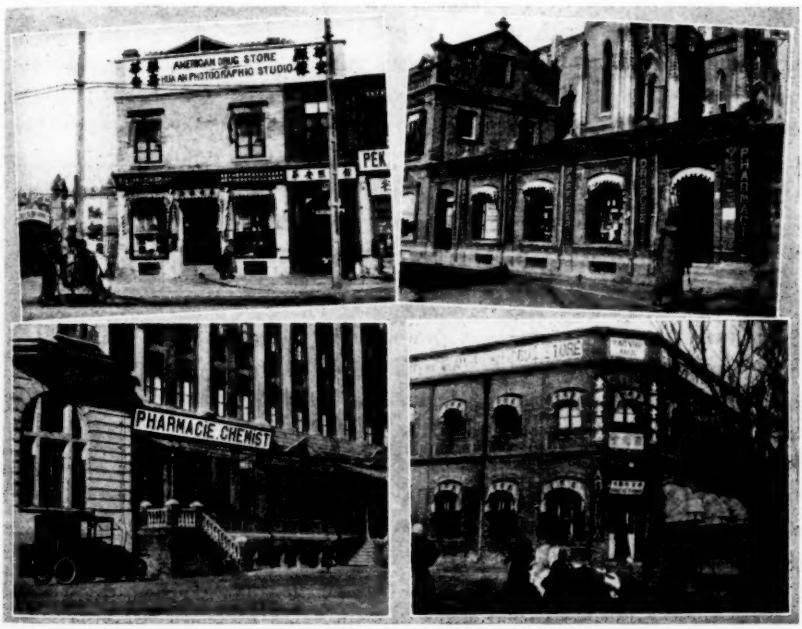
(Upper Right.) A view taken inside the Chinese drug store in upper left-hand photo—only two of the thirty assistants can be seen here.

(Lower Left.) Old Chinese drug store, showing the special hanging signs.

(Lower Right.) Small two-roomed old Chinese drug store on Hatamen Street, Peking—note the signs.

that all poisons are locked up in a special room—and these are never issued unless on the prescription of some Chinese medical practitioner who is known to the proprietor. This seems to have been the custom in China for many years. Another side of the courtyard is given over to the storage of all kinds of crude drugs—boxes are rarely used for storage purposes. The favorite method of storage seems to be wickerwork or matting baskets piled one on top of the other. The other side of the courtyard may be taken up by a grinding mill, where all the crude drugs are reduced to a fine state of subdivision by means of a stone mill. The motive power for turning the circular stone is usually to be found in the shape of a donkey, blindfolded.

The rooms on the upper floor around this courtyard are usually reserved as sleeping quarters for the apprentices and assistants in the drug store. One room is given over to the preparation of pill




(Upper Left.) The American Drug Store—a typical modern pharmacy in Peking—owned, and entirely run by graduate Chinese. This pharmacy is located on the famous Hatamen Street of Peking.

(Lower Left.) The newest modern pharmacy in Peking—also French—only opened one year ago. It is located in part of the Grand Hotel de Pekin and is in charge of a Frenchman.

(Upper Right.) Legation Pharmacy—another modern pharmacy in this city, well known to all travellers who have passed through Peking. It is a French establishment, but is managed by Chinese.

(Lower Right.) Tung Yueh T'ang—a modern pharmacy, run entirely by Chinese.

masses and here after the mass is prepared it is divided into small portions of the requisite weight then coated with white wax and each pill is carefully and neatly wrapped in red or white paper and transferred to one of the porcelain containers already mentioned in this note.

*Personnel.*—The drug store is under the entire command of the proprietor who alone decides the policy of the business—the hours of duty, the prices of the various items for sale, the number of apprentices who will be trained in his store, the salary of these apprentices and assistants. He decides when the apprentice has had sufficient training to be promoted a junior teacher, and in fact is "monarch of all he surveys" within his drug store. He usually has a relative who assists him in running the store and who takes charge in his absence. Then there are the "teachers" who do all the compounding of the physician's prescriptions presented at the store. Each teacher has four or five apprentices under him and it is his duty to train these boys day by day in the gentle art of Chinese pharmacy. Apprentices usually serve a period of three years training at a salary of about one gold dollar per month. After their training, if the proprietor thinks fit, he may give them a salary of gold $4 per month. Up till 1922 most of the drug stores provided food for all their employees free of charge, but since this date, owing to the increased cost of the common items of food in Peking, nearly all the drug store proprietors have ceased to provide meals for their assistants.

*Tung Jen T'ang.*[1]—This old Chinese drug store is reputed to be about five hundred years old. It is located in the southern section of the city of Peking and is probably the oldest drug store in this republic which is still doing business. It has been owned and run by the members of one family right from its foundation and the present proprietor is a descendant of the Chinese gentleman who almost five hundred years ago decided to make pharmacy his life work. The Tung Jen T'ang today is perhaps the most unostentatious of all the old drug stores in this city. It has no old drug store sign hanging above its door and there is nothing at all attractive about its exterior or interior and yet it is possibly one of the busiest drug stores in China. People come from far and near to purchase the various pills which have made this store famous.

*Market Drug Stalls.*—Many "Fairs" are held in different quarters of the city throughout the year and at nearly all these fairs one

may see drug stalls where special roots, barks or pills may be bought from a drug vendor who makes his living by travelling in some old fair. These men usually receive their early training in some old fashioned drug store and after their apprenticeship is over and they have a few years' experience they decide to purchase a few drugs and fit out a stall of their own.

*Chinese Patent Medicine Shops.*—During the past ten or fifteen years an entirely new kind of business has been established in this country—a business which in the opinion of the writer is more of a hindrance than a help to China in her present state—the patent medicine shop—where all kinds of packed goods are sold and where very little, if anything, is known about pharmacy as we know it in America or Europe today. Most of the patent medicines sold in these places are of Japanese origin; during the past five years some enterprising Chinese firms in Shanghai have commenced preparing their own patent medicines and putting them on the market. These shops are usually well lit and have very bright interiors in sharp contrast to the old fashioned dimly lit drug stores. They seem to stock anything that will sell, including tobacco, cigarettes, surgical appliances, glassware of all kinds and in some cases bicycles are stocked as a side line. They are as far removed from real pharmacies as fruit stores or tea shops.

*Chinese Owned Modern Pharmacies.*—There are quite a few modern pharmacies in this city owned, managed and entirely run by Chinese. They are real pharmacies where prescriptions can be accurately dispensed by fully qualified pharmacists. Most of the Chinese in charge of these pharmacies have received their training abroad and have graduated in pharmacy in one or other of the American colleges of pharmacy or have qualified in some of the European countries. They usually have some connection with Chinese medical graduates who have returned to this country after having taken their degree abroad. These doctors may consult at the pharmacy at stated hours every day. The pharmacies are equipped in a thoroughly modern way and contain all the usual accessories of our pharmacies at home. Naturally they also stock some of the well known patent medicines, but probably the major portion of their business is devoted to the dispensing of prescriptions.

*Foreign Owned Modern Pharmacies.*—There are only four pharmacies in Peking which are wholly or partially owned and man-

aged by foreigners and at the present time (March, 1925) only two of these actually have foreign pharmacists in charge of the dispensing. In a city like Peking where there are so many foreign legations, the pharmacist, whether Chinese or foreign, should be able to speak many languages. It is interesting to note that most of the Chinese assistants in the foreign pharmacies here speak English, while a few speak fairly good French and German.

*Hospital Pharmacies.*—No note on Pharmacy in Peking would be complete without reference to the various institutions in this city which have departments of pharmacy where prescriptions are compounded for both hospitals and out-patients. There are probably about twenty such places in the city. They vary in size from small one or two-roomed places to our pharmacy here in the Peking Union Medical College which we have described elsewhere.[2] One of the most interesting institutional pharmacies in the city, which the writer has visited, is the pharmacy attached to the Army Medical College, which is situated in the northern section of this city. During the recent disturbances in and around Peking it was our privilege to help in the fitting out of this pharmacy. It is run entirely by Chinese and reflects a great deal of credit on the assistants who carry on there from day to day.

Mr. C. O. Lee (Nanking) in a previous article[3] deplores the present condition of pharmacy and pharmaceutical training in China and the writer agrees with him that "Pharmacists will have to claim for pharmacy whatever place she is to have in China." In this connection it is of interest to note that during the present month (March, 1925) an attempt is being made to bring together all the people in Peking who have any interest in or connection with pharmacy. This is probably the first occasion in China when an attempt has been made to form some kind of pharmaceutical association or society—and it will be interesting to watch future developments. The suggested constitution of this society is appended for the information of readers of the AMERICAN JOURNAL OF PHARMACY.

**Suggested Constitution.**

1. This society shall be called "Peking Association of Pharmacy," "Peking Pharmacy Club," "Peking Pharmacist's Union," or "Peking Pharmaceutical Society."

2. The object of the society shall be to advance the science and art of Pharmacy, to promote friendship amongst pharmacists and to assist its members in every legitimate way.

3. All pharmacists and persons connected with or interested in pharmacy shall be eligible for membership.

4. Each member of the society is entitled to one copy of every publication of the society and one vote at all regular meetings.

5. The names of the candidates for membership shall be submitted to the secretary at least one month before the meeting at which they come up for election.

6. The annual dues of the society shall be: qualified pharmacists, $5; assistants and associates, $3, and students or apprentices, $1.

7. The officers of the society shall consist of a President, a Vice-President, two Secretaries (one for Chinese and one for English records), a Treasurer, and a committee. The above officers shall constitute the executive committee of the society and their term of office shall be for one year. All the above officers shall be elected by vote after nomination by members.

8. The executive committee shall meet at the President's call, for the consideration of expenditure, for the recommendation of membership, and for the arrangement of programs for the meetings. The executive committee shall also deal with all other matters of concern to the society and shall make recommendations to it for decision.

9. The society shall have regular meetings twice a month, one in Chinese and one in English, throughout the year. Special meetings shall be called at the discretion of the executive committee.

10. For the election of members, change in the constitution, extraordinary expenditure, and the dropping of members, a three-fourths vote of those present at any meeting shall be required; for all matters of minor importance, a single majority shall be sufficient.

11. The place of meeting shall be the small Auditorium of the P. U. M. C., kindly lent by Dr. Y. Y. Tsu.

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REFERENCES.

[1] Chen, K. K.: *Annals of Medicine.* In Press. January, 1925.

[2] Cameron, J.: *China Chemist and Druggist Review.* In Press. February, 1925.

[3] Lee, C. O.: *China Med. Journal.* January, 1925.

# A VOLUMETRIC METHOD OF ASSAYING MERCURIC IODIDE, MERCURIC CHLORIDE, AND SOME OTHER MERCURY COMPOUNDS.

By S. Ellman.

$HgI_2$ in accordance with the U. S. P. IX is assayed by the electrolytic method. The main objection to this process is the expense of special apparatus. A search through chemical and pharmaceutical literature did not disclose any record of a satisfactory alternate method for the assaying of $HgI_2$. While the volumetric analysis of most of the mercuric compounds is carried out by titration with N/10 KSCN V. S., this method, however, cannot be applied to $HgI_2$ and $HgCl_2$, as the presence of any halide salt interferes with the titration and causes an error. $HgI_2$ has the additional disadvantage of being insoluble in water and acids. The method under consideration for the $HgI_2$ may be made either volumetrically or gravimetrically and can easily be carried out in slightly acid or neutral solutions.

## The Gravimetric Method.

$HgI_2$ is dissolved in a 20 per cent. solution of KI. If the solution is saturated with $H_2S$, HgS is precipitated quantitatively. The following table represents results of assaying two samples of $HgI_2$ marked as U. S. P. chemicals, and made by reliable manufacturing chemical houses.

| *No. Exp.* | *Sample.* | *Amount $HgI_2$ Used.* | *Amount HgS Obtained.* | *% $HgI_2$* |
|---|---|---|---|---|
| 1. | A | 0.4688 Gm. | 0.2396 Gm. | 99.85% |
| 2. | A | 0.8472 " | 0.4326 " | 99.70% |
| 3. | B | 0.2396 " | 0.1220 " | 99.68% |
| 4. | B | 1.2180 " | .6194 " | 99.84% |

The HgS was in each case washed free of sulphur, dried and weighed in the same manner as the HgS obtained from $HgCl_2$, according to U. S. P. IX, page 214. The analysis of $HgI_2$ may therefore be stopped right here. But to get away from a gravimetric to a more suitable volumetric process the following method seems to be most satisfactory. In general it consists in adding to the HgS an excess of Iodine V. S. which will form $HgI_2$ with the separation of sulphur. The excess of iodine is then titrated with sodium thiosulphate V. S.

## The Volumetric Method.

### Procedure.

Dissolve about 0.5 gm. of $HgI_2$ which has been previously dried to constant weight in a desiccator over sulphuric acid in about 10 cc. of a 20 per cent. KI solution. Add distilled water until the volume measures 50 cc., saturate the solution with $H_2S$ and allow the ppt. to settle. Filter and wash the ppt. with cold distilled water until the washings do not affect lead acetate paper. Transfer the filter paper with the ppt. to a 250 cc. flask, add 10 cc. of 20 per cent. KI solution and 30 cc. of N/10 Iodine V. S. Stopper tightly with a paraffined cork through which a glass tube is passed connecting with a 50 cc. flask containing 10 cc. of KI solution (10 per cent.). Place the 250 cc. flask on a water bath and heat for about a half hour. Shake the 250 cc. flask from time to time till no more black particles are visible. Now cool and wash the tubing and cork with the KI solution of the smaller flask and titrate the contents of both flasks with N/10 $Na_2S_2O_3{\cdot}5H_2O$ V. S. Starch T. S. being used as indicator. Run a blank test, using the same amount of N/10 Iodine V. S. and calculate the per cent. of $HgI_2$ as follows:

$$\frac{454.44 \times \text{Factor } Na_2S_2O_3{\cdot}5H_2O \times (A-C) \times 100}{2 \times 248.22 \times \text{Wt. Taken}}$$

A = cc. N/10 $Na_2S_2O_3{\cdot}5H_2O$ V. S. used in blank.
C = cc. N/10 $Na_2S_2O_3{\cdot}5H_2O$ V. S. used in the determination.

The chemistry involved may be expressed in the following equations:

$$HgS + I_2 = HgI_2 + S.$$
$$HgI_2 + {}_2KI = K_2HgI_4.$$

The excess of iodine is titrated.

## The Iodometric Method.

Since iodine is capable of chemically combining with freshly precipitated HgS, with the separation of sulphur, the method of analysis described here for the assay of $HgI_2$ may also be successfully adopted for many other mercury compounds, as: (1) $HgCl_2$, (2) Ammoniated mercury, (3) Donovan's solution, (4) Mayer's Reagent, (5) Nessler's Reagent. Instead of washing the ppt. until free from sulphur, drying and weighing as the U. S. P. IX recom-

mends in the assay of $HgCl_2$ and ammoniated mercury, the iodometric method described here is simpler and less tedious. This is also true with the assay of $HgI_2$ in Donovan's solution (Liq. Arseni et Hydrargyri Iodidi), the only modification being to wash the combined sulphide with $Na_2CO_3$ solution with the object of removing the $As_2S_3$, until the washings do not respond to the Arsenic test. (Carefully acidify washings with dilute HCl and pass in $H_2S$. No turbidity occurs within five minutes.) It may be recalled that the U. S. P. IX recommends the assay of $HgI_2$ in Donovan's solution by a process of reduction to metallic Hg by the use of formaldehyde, dissolving the Hg in $HNO_3$ and titration with KSCN. According to some authorities this method is not satisfactory, as the Hg cannot in this process be collected and washed without loss.

Mayer's reagent, which is a solution of $HgI_2$ in KI, can be treated in the general way if it is to be assayed for $HgI_2$.

Nessler's reagent, which is an alkaline solution of $HgI_2$ in KI, would have to be acidified with HCl before proceeding as above. A number of experiments carried out in distinctly acid solution gave uniformly satisfactory results.

## Precaution.

The following factors have to be taken into consideration to obtain satisfactory results:

1. Strength of solution. The concentration or dilution of the solution has an important bearing upon the accuracy of the process. If the solution of $HgI_2$ is too concentrated not all of the Hg will be precipitated, but if the solution is highly diluted a colloidal suspension instead of a precipitate is obtained and filtration is difficult. It is not necessary to have the exact dilution suggested, but it was found to be the most satisfactory in the experiments conducted. Any large deviation will cause an error, as indicated in the following table:

| *No. Exp.* | *$HgI_2$ Used.* | *% Found.* | *Remarks.* |
|---|---|---|---|
| 1. | 0.4668 Gm. | 98.01% | 25 cc. instead of 50 cc. dilution used. |
| 2. | 0.7370 " | 94.26% | 300 cc. " " 50-60 cc. dilution used. |
| 3. | 0.3288 " | 96.54% | 25 cc. " " 50 cc. 50% also KI solution used. |
| 4. | 0.6498 " | 92.23% | As under No. 3. |
| 5. | 0.5206 " | 92.72% | " " " |
| 6. | 0.4698 " | 96.64% | " " " |

# ABSTRACTED AND REPRINTED ARTICLES

## COMMONWEALTH FUND—PHARMACY STUDY.*

### An Introduction to the Pharmacy Report.

(A TENTATIVE DRAFT)

Dr. W. W. Charters, Director of the Educational Research Committee of the Commonwealth Fund, presented the following preliminary report of the work of the committee covering the past year and a half at a joint meeting of the National Association of Boards of Pharmacy and the American Conference of Pharmaceutical Faculties held during the week of the annual convention of the American Pharmaceutical Association at Des Moines, in August. This report was enthustiastically received, stimulated vigorous discussion and was heartily commended. It is but preliminary and introductory to the complete and voluminous report of the committee, which is expected to be finished and ready for distribution during this present October or the following month. As an earnest of the extreme value to characterize the complete report, this introductory portion will be read with great interest by pharmacy teachers and practitioners generally.

Pharmacy is an ancient and honorable profession. Its beginnings are lost in the mists of antiquity and its history is replete with substantial accomplishments. It was born in the same matrix as medicine and is the original source of many forms of research. Numerous investigators who have made epochal contributions to science and art have been enrolled among the numbers of its followers. Today pharmaceutical research is scholarly and productive. In the laboratories of two continents, scientists are industriously and effectively studying the problems of the field.

Yet, at the present time, the profession is undergoing a heavy barrage of criticism. The assertion has been made that it has been commercialized and has sunk to the level of soda-fountain dispensing and the rule-of-thumb shop keeping. Claims are made that it has become a purveyor of illegal drugs and liquors that keeps just within the boundaries between legality and crime. It is usurping the functions of the doctor by counter prescribing. It is said that it is pseudo-scientific without intelligent grasp of the sciences which it pretends to utilize. Some critics say that in the effort to commercialize the occupation, the ancient professional morale has been lost, with the result that the occupation has ceased to be a profession and is now become a trade.

*Reprinted from *American Druggist*.

It is, therefore, of interest to examine this vocation which in numbers is not inconsiderable and in history is rich and worthy. To know with some definiteness just what the pharmacist does, what place he fills or may fill in society, how much he needs to know, and what sort of training should be given him in order that he may properly and intelligently fulfill his functions is a matter of major social importance. The criticisms just enumerated become immaterial if a picture can be drawn showing the full round of the responsibilities of the pharmacist and the amount, the depth, and the extent of the training which is needed adequately to fit him to fulfill his obligations.

With some such idea in mind, the study of the curriculum of pharmacy was undertaken. The hope was entertained that by the use of the recently developed technique of functional curriculum construction, the content of courses of study in professional schools which train pharmacists could be determined with quite considerable definiteness and detail.

The results of two and one-half years' work by a technical staff and several consultants are presented in this report as the findings of the study. The initial impetus was given to the investigation through appropriations totaling $34,000 which were made by the Commonwealth Fund, and to this amount is to be added in time and effort and quality of work the equivalent of this sum through voluntary personal assistance by members of the craft.

The method underlying the study may be simply stated. It is a functional study in which the first step is to determine just what the pharmacist does, and the second to discover what he must know intelligently to perform these duties. The method so stated appears on the surface to be extremely simple. When, however, it is applied to the profession in detail, innumerable complications emerge. Some of these problems have been handled in a satisfactory manner; some not so well. The study therefore, has at best produced results only approximately accurate.

The signficant difference between the functional approach and the traditional attack lies in one conspicuous distinction. The content of current curricula has been selected upon the basis of individual opinion and conference consensus. One man or a group of men have decided on the basis of their own judgment what should be included in the course. The bias of the individual and of the specialized department has, therefore, had a disturbing influence, with

the result that frequently the permanence and emphasis given to a subject in a professional school have been decided by the personal forcefulness and combativeness of the individual who has sponsored the material rather than by its usefulness in training the student who has entered the profession.

The content of this curriculum has been derived functionally from a study of the needs of the profession. The functional approach is objective. Completely applied, it accepts the opinion of no one person or group of persons. It seeks to determine with care and exactness the duties of the profession, and to derive by objective methods the facts and principles necessary for the mastery of the duties with accuracy and definiteness of detail. Such is its ideal —to substitute fact for opinion. In this study, it has not been possible to realize this ideal to completeness. Gaps occur, but these have been reduced as nearly to a minimum as the staff could accomplish. Facts have been sought diligently and persistently, and where these were not available consensus of opinion of experts was utilized in preference to the opinion of individuals, and in no case was the opinion of people other than experts sought or utilized. That a very considerable mass of facts has been collected and used is apparent to any who read the report with care.

### The Activities and Duties of the Pharmacist.

In prosecuting the study, obviously the first step was to analyze the life of the pharmacist to discover his duties, activities, problems, difficulties, traits of personality, and obligations. These will now be described.

The initial policy decided upon was that for purposes of this study, the pharmacist who is to be trained is the one who in general terms is the proprietor of the neighborhood drug store in the city and of the pharmacy in the small towns throughout the country. Specialists in manufacturing houses, in Federal and state laboratories, or in other universities were not considered. For these, specialized courses should be developed. The field of investigation was to be limited to a study of the "practicing pharmacist" or druggist constituting approximately over 90 per cent. of the graduates of colleges of pharmacy.

It is fully recognized by the committee that courses should be offered which will train workers in specialized branches of pharmacy by those colleges preparing to do so. Specifically, courses should

be offered for persons who wish to become industrial pharmacists, analysts, hospital pharmacists, teachers of pharmacy, etc. In preparing such courses, the techniques of curriculum construction such as those used in this study may well be employed, but so far as the present undertaking is concerned the Advisory Committee feels that the study should be confined by necessity to the examination of courses formulated to train the retail pharmacist.

The first problem was to analyze this pharmacist, thus vaguely defined, in order to make the picture definite. It was finally agreed during the course of the two-year study that such a pharmacist had twelve groups of duties and responsibilities.

1. In the first place, he is a man as well as a pharmacist and as such he has certain obligations and satisfactions in connection with his family, as a husband and father, with his country as a citizen, and with himself as an individual. He must possess the qualities of intelligent and forceful manhood; he should enjoy life, art, and religion; physical and mental fitness are obligations to his friends and family and a source of pleasure to himself; and other similar matters should all be classified as extra-vocational activities.

At the outset, it was decided that a study of this group of activities would be omitted, not, however, because it is not an important element in the curriculum of the college of pharmacy. Every college student—irrespective of vocation—can demand as his right the training necessary to make him a "cultured" man. But the task of determining just what is the content of this extra-vocational curriculum is itself a major problem and one much more complex than is the determination of the vocational curriculum. It is an independent study which when completed from the functional point of view may be incorporated without material modification into the curriculum of each professional school.

2. When we leave the extra-vocational group and proceed to analyze the vocational activities of the individual who follows pharmacy as a profession, the first and most significant group to be attacked is the group of personnel activities—those that pertain to the human, the psychological, and the ethical ingredients of professional life. It is indisputable that the character and the personality of the pharmacist are essential in the proper conduct of his business. Then, too, the development within himself of a professional morale displayed in his pride in his profession is an obligation of each member of the craft. Those who train students to be followers of the pro-

fession must train them to be persons to serve the public. The pharmacist must display reasonable efficiency in handling people and adequate proficiency in living with them with kindliness and forcefulness. Finally, he will need to have due regard for those rules of ethics of his profession which have stood the test of time and have demonstrated their fundamental value.

The investigation has considered these four problems. Thirty-three qualities needed for the successful pursuit of pharmacy have been collected, defined and ranked in order of importance. The judgment of druggists, faculty members, and customers has been secured to see whether or not those traits which are thought to be important by the craft are considered to be equally important by the public for whose service the craft has been established. The development of morale has been investigated to discover the means by which faculties may cause it to grow in the student bodies. The methods of efficiently handling people have been studied to the point of collecting weaknesses in selling ability, but no attempt has been made to present efficient methods for overcoming these weaknesses. This omission is due to a cause to be stated later. The codes in present use have been collected but a new code has not been devised. That task if it is necessary is one that has to be performed by the poet rather than the scientist.

3. A third group of activities which emerges upon further study is that group commonly designated by the term commercial pharmacy. Just where "professional" pharmacy ends and commercial pharmacy begins is not clear. The extremes are, of course, obvious. The sale of soda-fountain products is clearly a commercial activity, while the filling of prescriptions is professional, but the "professional" druggist must buy and sell many drugs and articles; and buying and selling is a commercial activity. Moreover, ability to buy and sell efficiently is the basis for permanence in the pursuit of professional activities.

From the distinction between the two fields—a distinction which nobody is able completely to define—it is clear that the druggist has to manage his business, to buy and sell, to advertise and display his merchandise, and to obtain profit sufficient to maintain his business and to secure the necessities, the comforts, and some of the luxuries of life.

Because the study was approached from a professional angle which centers around the filling of prescriptions, the advisory com-

mittee recommended that the study of commercial pharmacy should be omitted. This recommendation followed the suggestion of the director who felt that the study of professional pharmacy, as currently understood in the profession, was a task sufficiently large for one undertaking. However, as the study progressed, it soon became apparent that the commercial phases of pharmacy were so inextricably entwined in the structure of professional pharmacy that no study of the latter would be complete without an investigation of the former. As a consequence of this conviction, the field of commercial pharmacy has been explored to a minor degree and the recommendation is made that a complete investigation of that field should be made at a date as early as possible with the use of the technique employed in the present study. Only by the completion of the study of commercial pharmacy can a complete professional curriculum be secured.

The studies made in the field are the following: Inventories of pharmacies representing all great sections of the nation and important types of industrial centers were analyzed to determine the articles most frequently carried by a typical drug store. A form was prepared to show what facts should be taught about each article carried. Specifically, the following items were considered useful. The merchandise information necessary intelligently to sell the articles carried in drug stores should include the uses to which the articles may be put, the qualities of the articles, their basic ingredients or materials, the methods of manufacture, a knowledge of dangerous ingredients that might be used, together with their properties, proper methods of using the articles, and the reasons for legitimate differences in price. Furthermore, a list of the difficulties encountered in the mastery of the art of salesmanship was made through interviews with many practical druggists and members of faculties. Finally, a study was made of pharmaceutical English. This included a list of the common oral errors of speech and the ways in which written English was used by the pharmacists.

4. The group of duties which has been admittedly central in this investigaton is that concerned with the filling of prescriptions. Exactly 17,577 prescriptions were analyzed in order to find out just what the pharmacist needs to know to fill them intelligently. These prescriptions were representative of all sections of the nation and in number were adequate for practical teaching purposes. The technique used in the analysis of the content of the subjects necessary

to be taught in order to fill them is described in the proper place later in the report.

5. The pharmacist normally manufactures some of the products which he sells or uses in prescriptions. The amount of manufacturing that may or should be carried on in a pharmacy is at present a topic of lively debate. Originally the pharmacist manufactured everything that he used or sold for the quite sufficient reason that no one else had the skill to perform the operations. However, with the development in recent years of large manufacturing organizations which employ experts possessing much greater skill in manufacturing and in standardization than does the average pharmacist and which provide much more efficient equipment than is found in a typical drug store, the situation has changed. In many cases drugs can now be prepared with greater efficiency and sold at a smaller price by manufacturers than is possible by manufacturing them in a pharmacy.

The trend, therefore, is toward purchasing and away from manufacturing in the store. So strong is this tendency that some fear is expressed both by the faculties and by thoughtful pharmacists that purchasing is getting out of hand. It is felt that the formation of the thoughtless habit of buying everything possible leads to the purchase not only of those drugs which may safely be purchased but of others that should be made on the spot to safeguard purity and strength. It is pointed out by these men who advocate local manufacturing wherever feasible that the pharmacist who prefers to purchase overlooks among other things many opportunities for increasing profits through the manufacture of "own preparations" to replace proprietaries and advertised brands.

It is, therefore, of interest to note just what it is feasible to manufacture in the pharmacy. To throw light on this question, a survey of 1131 pharmacies of national geographical scope was made to discover what substances are now being manufactured in pharmacies. This provided a picture of current practices. To obtain a picture of best practice in order to show what the pharmacist might profitably manufacture with simple equipment on his own premises, a supplementary study was made. One hundred practical druggists prominent in the National Association of Retail Druggists and fifty members of the American Conference of Pharmaceutical Faculties who teach the subject of pharmacy were consulted. They were asked to check on a quite complete list, those products which should

normally be purchased, those which should normally be manufactured by the pharmacist, and those which might under the conditions specified by the checker be manufactured by the pharmacist.

Parenthetically it may be said that the judgments of the faculty do not differ materially from those of the practical druggists. This agreement is surprising to those who have felt that the faculties are likely to be highly theoretical and advocate the manufacture of many products which the practical pharmacist knows it is preferable to purchase.

The returns provide authoritative data to guide the pharmacist in his selection of the products which he should preferably manufacture, should buy, and should manufacture under unusual conditions. They will also guide the teachers of manufacturing in their selection of material in which to instruct the students in their courses.

When those findings had been prepared, the lists were used as a basis for determining what a pharmacist should know to perform skillfully the processes of manufacture. This information is found in the body of the report.

As an appendix to this division of the study, the apparatus necessary for the manufacture of the products which a pharmacist should manufacture was noted. From this and a similar study for compounding, a standard equipment for compounding, manufacturing and testing in a pharmacy was compiled—particularly for the guidance of young pharmacists who are installing a new equipment in their places of business as well as for the information of experienced pharmacists who may wish to possess complete equipment.

6. The pharmacist is the chief source of information and materials for the control of insects, fungi and parasites. He has a definite responsibility for the carrying of insecticides, fungicides, fumigants, and similar products and for the giving of information for their use and their dangers in use. This is particularly necessary in rural communities where commercial uses are important as in sections engaged in the fruit industry.

Materials upon this topic have been collected with the authoritative cooperation of certain federal bureaus at Washington.

7. It is one of the duties of the pharmacist to be competent to read the *United States Pharmacopœia* and the *National Formulary*. The profession is fortunately situated in having at hand two such authoritative sources of information. These the pharmacist continually consults. They have accordingly been extensively and con-

stantly used as a basis for determining in part what terms in many subjects, such as botany and chemistry, the pharmacist must be familiar with, and therefore in part what information should be included in these courses in college.

8. Conspicuous among the duties of the pharmacist is the group which deals with public health. These activities are the largest of his functions in connection with social and community life. Filling prescriptions correctly is, of course, important to the public as are also the display and sale of reliable products; but in the service to public health, the pharmacist serves the public in a very unique way. There are, of course, many sources from which the public may secure accurate health information—the public schools, the newspapers, and the publications of federal, state, and private agencies. These all contribute their part to the solution of the problems, but the information that they provide is general and as such has to be made specific in order to meet the personal needs of the one who is confronted with specific troubles of his own. To give this personal assistance the doctor is at hand. But many people are afraid of physicians and hospitals. Moreover, the physician keeps office hours which are relatively inconvenient for people who are busy with their own affairs. In addition to this, charges for consultation and treatment even though modest often keep the public from seeking the advice of a physician.

The pharmacists are, therefore, more strategically situated to give personal advice upon matters of public health in connection with which they are informed than is any other group of individuals. The information is given free of charge and can be secured within easy walking distance of the home. The materials necessary for the control of the health problem are in stock and can be promptly obtained. Queries about health facts are casually asked by interested customers who have entered the store for the purchase of articles. Odds and ends of information not easily accessible in the health literature can be gained in such conversations with a pharmacist. *A well-informed pharmacist is the best single individual to disseminate information about public health.*

Much has been said about the multiplication of pharmacists in the community, and the feeling has been expressed that they are becoming too numerous—so numerous, in fact, that they must seek unprofessional means of securing the profits or income necessary to maintain themselves. From the point of view of the dissemination

of health information and of other forms of scientific information in the community, it is doubtful if we are in immediate danger of having too many pharmacists. If a pharmacist filled prescriptions and sold only drugs and products very closely related to healing, the number of pharmacies would be so small in a community that access to them and to the information which they provide would be difficult. It seems therefore, if the pharmacist is well trained and maintains his professional interest, to be entirely desirable from the point of view of the public to have as many pharmacists as can support themselves by the use of all legitimate means. The danger in the situation lies in the fact that the pharmacist in his effort to expand his non-professional business may lose his professional. This danger can be guarded against, however, through a thorough initial training and the development of a strong professional morale in colleges of pharmacy.

The drug store is also the natural place to which to take victims of accidents for first aid because in it will be found both first aid materials and advice concerning the administration of the materials. Moreover, the pharmacist participates in public health movements by serving on committees and assisting in campaigns as a professional man. It is not enough for him to give such information as he has when asked for it; he is obligated to become an actively participating force in the elevation of the health index of his community.

To secure the information concerning these activities which should be taught in course, reliance has been placed chiefly upon the United States Health Service which has cooperated with great interest and industry in outlining the material which they believe will assist them in their functions of disseminating health information. This material will be found in its appropriate place in the body of the report.

9. A quite debatable duty is the dissemination of information about diseases which are outside the field of public health, as commonly understood, and are therefore by custom placed within the field of the physician. In general, it is considered to be unprofessional for the pharmacist to diagnose and prescribe remedies. Prescription and treatment of diseases are considered to be the duty of physicians alone. This is not fully realized by the public. When the common man has "something wrong with him," his first impulse is not to go to a physician for the reasons mentioned above. He asks the advice of his lay friends and if he needs something for

his trouble, he asks the druggist. In the ordinary course of events, the pharmacist is consulted by the people of his neighborhood, and the less personal information they have on health matters, the more they depend upon his advice when given. Feeling some responsibility as a friend and consultant, he quite naturally will give all the information at his command as matters of neighborliness and good business service.

Unfortunately, however, for the pharmacist who is more willing than well informed, the "troubles" of the common man are of two classes: the simple and the dangerous. If the druggist is not intelligently informed, he may confuse the dangerous with the simple, and as a result give inaccurate advice about diseases about which no one except a physician has sufficient knowledge. At this point lies the danger attached to counter prescribing.

It is a foregone conclusion, however, that no laws will prohibit the pharmacist in actual practice from giving advice about the health troubles of his customers. If he thinks he has the information, he will give it. Every human being will give advice. Love of advising is a fundamental trait of human nature.

Therefore, it is worth considering the question whether the method to be used to abolish counter prescribing is not to keep the pharmacist in ignorance about diseases or to give him more information. When he learns with definiteness that certain diseases are not easily recognized by anyone except an expert diagnostician, and learns further that what seems like the symptoms of simple ailments may easily be indicative of serious diseases, he will cease to give any other advice to the customer under these conditions than to consult a physician. The pharmacist who counter-prescribes for dangerous diseases may do so because he does not know enough.

It may be necessary in college to teach him more than the mere statement that he should always tell his customers to go to a physician for all kinds of ailments. As a matter of fact, there are many troubles which are so obviously simple that the housewife is competent to care for them. If a child cuts his finger, the natural prescripton is some simple antiseptic agent. If an adult has corns, the layman can safely prescribe better-fitting shoes and corn pads. Prescriptions for simple ailments are normally made and will always be made by the pharmacist irrespective of legislation or professional custom. The danger lies entirely in the confusion of the simple with the dangerous. The problem of the college of pharmacy is to

know how much information should be taught in order that the pharmacist will keep far within the limits of safety.

Just how much the pharmacist should be taught about diseases is not an easy question to answer. He should certainly be taught as much as the layman is taught in school, in the newspaper, and through those publications intended for laymen which are issued by competent health agencies, such as the state and federal public health departments, and national and state medical associations. He should certainly not be taught as much as the physician, whose business it is to diagnose expertly and to treat disease. The amount of information to be taught him lies somewhere between the two.

The Advisory Committee does not include such material in the curriculum in pharmacy which it presents. It recommends, however, that consideration should be given to the question of pharmaceutical associations in cooperation with medical associations.

10. The pharmacist is a source of other types of scientific information. He has learned in school and from experience a mass of facts about the applications of chemistry, physics, and other subjects to the simple problems of the layman. He is an excellent source of information because he is conveniently in contact with his customers. The layman has easy access to him at any time. When well-trained and possessed of accurate information, he is of very great value as the disseminator of a wide range of miscellaneous scientific information.

However, the performance of this function of providing miscellaneous scientific information ought to have no influence upon the curriculum of the colleges. The queries of customers are so numerous and so varied that it would be futile to attempt to prepare the pharmacist to answer all of them. Rather the position the committee takes is that he should answer the questions about which he has gained information in course or from experience and feel no responsibility to answer queries for which he has not secured information from these two sources. Therefore, since the information necessary to perform this service is merely a by-product of his courses in college, no attempt has been made in the study to collect miscellaneous queries or the information necessary to answer them.

11. The vocation of pharmacy is regulated by law to a degree quite unusual among the professions. The national government regulates the sale of narcotics, alcohol, insecticides, etc. Each state enacts many statutes dealing with the activities of the profession, and in some cases duplicates the national laws with state laws which

add restrictions to the federal statutes. From the laws are derived regulations which still further prescribe the conduct of the pharmacist. It follows, therefore, that an important duty of the pharmacist is to familiarize himself with these federal and state laws which pertain to his business.

In this study we have made certain suggestions to teachers of pharmaceutical jurisprudence and for their information have had compiled by experts a statement of those federal and state laws which are most commonly in danger of violation by pharmacists.

12. Finally, the pharmacist owes it to himself, to his profession, and to his community to continue to study and grow in information and skill after he has graduated from college. It is his duty to read professional journals with alert attention to new ideas. He should actively participate in the cooperative enterprises and association meetings of the craft. He should recruit young men of character to the profession, and in so far as he has the time and ability should carry on professional research.

In connection with this group of activities, the staff has collected methods by which the colleges of pharmacy develop in their students facility and interest in reading current periodicals and authoritative texts.

In conclusion, then, we present this picture of the typical pharmacist which the college of pharmacy is to train. He is a man with interests and obligations outside of his profession; his personality and character should be of a high degree of competence. In his profession, he buys and sells a wide variety of products, he fills prescriptions and manufactures those products which it is advisable not to purchase. He assists in the control of insects, fungi, and germs. He is a valuable source of information on public health and on other scientific matters. As a pharmacist, he intelligently reads the authoritative treatises of his profession; he endeavors to understand and obey the laws of his country; and he continually labors to keep abreast of his profession.

The functions of the pharmacist are changing; the outlines of the field are not definitely fixed. It is, therefore, possible that other groups of individuals might add or subtract from the foregoing list. The Advisory Committee in conference debated the inclusion of other duties, but for purposes of this study, the curriculum of pharmacy presented in this report is derived from the enumerated functions. To others is left the task of adding such other duties as they may wish.

## Contents of the Curriculum.

From the foregoing activities of the pharmacist, the raw material of the curriculum was derived by methods described later in this report. At this point, a sketch of the methods used is presented to orient the reader in his study of the report as a whole.

The profession of pharmacy is fortunate in having a syllabus to use as a basis for the courses in the colleges of the craft. This is revised at intervals by a committee representing the American Conference of Pharmaceutical Faculties, the American Pharmaceutical Association, and the National Association of Boards of Pharmacy. This study disregarded the syllabus until the investigation has been completed. It was felt that if this were done and the study were made independently, it would serve as an objective check against the syllabus, and the hope was entertained that the findings of the study might not materially differ from the syllabus. This statement is made to indicate the fact that the project was not carried out in an atmosphere of destructive criticism and hostility to the syllabus.

A study of the informational content of the curriculum began with the analysis of the information necessary to fill prescriptions. These to the number of 43,704 were collected from fifteen centers from the following states: California, Illinois, Louisiana, Massachusetts, Minnesota, Missouri, Nebraska, New York, Oklahoma, Pennsylvania, Utah, Virginia and Washington. Of these, only 17,555—representing all of the foregoing states—needed to be used because with the completion of this number new items appeared so infrequently that they could be disregarded in the curriculum. To the prescriptions were added at the proper points a survey of 1200 pharmacies in twelve centers. This provided the staff with information concerning conditions now operating in the practical conduct of the vocation. From his survey, data were obtained about the use pharmacists make of toxicology in connection with cases of poisoning, what they actually manufacture, the apparatus they have for manufacturing and compounding, the crude drugs sold over the counter in open packages, what attention they pay to official methods of preservation; their attitude toward the practice of first aid, the extent to which they perform chemical and biological assaying, the amount of bacteriological technique that is used, the journals and reference books subscribed to, the professional organizations to which they belong, and

the extent to which they cooperate with physicians. To this survey were added the results of a questionnaire responded to by leading druggists and by faculty members for the purpose of checking the extent to which manufacturing was practical in pharmacies. The material obtained from the United States Public Health Service and from the Bureau of Entomology was likewise used as a basis for analysis. Interviews with practicing pharmacists and faculty members provided information concerning the essential qualities of good pharmacists, the uses of written English, methods of developing morale, and the selling difficulties of young salesmen. Inventories were analyzed and the items were tabulated and totaled in twenty-eight drug stores. These stores represented the followng centers: Neighborhood stores in Boston, Brooklyn, Chicago, Detroit, New Orleans, Oklahoma City, Ottawa, Ill.; Richmond, Va.; Seattle, St. Louis and St. Paul; other stores in sections primarily interested in the following industries: Automobiles, cattle, chemicals, cotton, dairying and vegetables, and still other rural stores in Nebraska, New Jersey, Oklahoma and Virginia. From these was obtained a list of items carried in the drug stores and the products were arranged in order of frequency of occurrence by stores. This material was chiefly of use in forming a basis for a course in merchandise information necessary for the druggist as a part of commercial pharmacy. From experts, matters of individual opinion were in a few cases secured. Finally the *United States Pharmacopœia* and the *National Formulary* were used as a basis for the derivation of information concerning chemistry, physics, and other subjects which the pharmacist would need to learn in order intelligently to read the content of these two books.

These in brief are the sources from which the curriculum was derived. Always to direct the selection of details within the subjects, the query was constantly put to the staff by themselves. "What justification have we for the inclusion of this item?" If, when reference was made to the foregoing sources, no justification was found, the item was omitted.

Very soon after the study was begun, it became apparent that the most feasible method of attack upon the problem was through the tentative listing of subordinate studies based in general upon the subjects which seemed to be necessary for an intelligent grasp of the duties of the profession. The subordinate studies listed for independent investigation were the following: Jurisprudence, ethics, type of ingredient, active constituent nomenclature, arithmetic, English, dos-

age, chemistry, toxicology, physiology, pharmacy, botany, microscopy, physics, chemical assaying, biological assaying, bacteriology, immunology, identification, authoritative formulæ, preservation, adulteration and contamination, mechanical apparatus, geographical source, reception, manufacturing, compounding, dispensing, traits, morale, purchasing and selling, history, current literature, public health, merchandise information, and first aid. These studies were undertaken one by one and modified as the occasion demanded and completed to the extent reported.

Once the studies were under way, a few problems of fundamental importance arose. The first of these emanated from the overabundance of material to be covered in courses of pharmacy. The question of selection of material became pressing. To solve this problem, some basis for selection was necessary. The basis chosen was that of relative importance. In short, when the teacher is in doubt about what to leave out, the least important should be omitted. When importance was in turn analyzed, it was found to depend upon frequency of use, potency, and type. For instance, in deciding which of the ingredients to treat in a course of pharmacy, it is necessary that all types—galenicals, chemicals, etc.—should be considered. Within these type groups, those of highest frequency should be selected if all could not be treated. But whether frequent or not, all potent drugs should be considered.

It is hoped, therefore, that the frequency tables so freely provided in the report will be of use to the instructors in selecting the items to use for illustration and intensive study within the types and groups. Frequency does not completely determine selection, but it is one important factor.

In addition to the principle of selection on the basis of importance, the principle of logical derivation of content from the function was constantly applied. In brief, when the function was analyzed, as the filling of prescriptions, the most efficient methods of performance were sought. What was unnecessary was omitted and all that was necessary was searched for. This is the essential principle of scientific curriculum construction.

At once arises a distinction of great significance to the curriculum. In a profession it is necessary to know not only the methods of performing the activities of the vocation; the principles and fundamental facts upon which the methods are based must also be mastered. It is necessary to know not only how to perform the activity,

but to understand why the methods used operate successfully. If the fundamental principles are not taught, the vocation is not a profession; it is merely a trade.

This distinction leads directly to the fundamental subjects such as chemistry and physiology. Some knowledge of these is necessary for the completely intelligent grasp of the practices of pharmacy. These subjects are studied to find out just what facts and principles in each it was necessary for the pharmacist to know. However, it became immediately apparent that the term "intelligently to understand the practices of pharmacy" involved consideration of the depth to which the subject should be studied. There is not a theoretical level at which the study of the subject matter would automatically stop. Therefore, rules of delimitation became necessary in answer to the question "How far does the pharmacist need to go into this subject?" Specifically, "Does he need to know physiology of plants?" Clearly he does not because he uses botany only for the identification of drugs and this is a matter of structural botany. Again, "How much does he need to know about bacteriology in order intelligently to sell biologicals?" This is an open question. Thus rules of delimitation were during the progress of the study being constantly formulated by the Advisory Committee. These are stated specifically in respective sections of the content report. The individual reader may not agree with the rules, but it is more satisfactory to disagree over a general rule than over a specific fact. Once a decision on the rules has been reached, specific details may be derived with quite logical certainty.

No attempt has been made to organize the material into courses. The topic headings of the content report merely serve as a convenient method of grouping facts that seem to cohere. Whether the material under those headings shall be taught in separate courses or whether they shall be combined to form courses or taught incidentally in connection with other courses was not considered in the study. Specifically, the committee did not consider the question of whether dosage should be taught as an independent subject in the curriculum or whether it should be taken up when drugs are studied in other subjects. All that it attempted in this study is to indicate what needs to be known. The organization and order of presentation of facts are left to the instructor. This is a study of the raw materials of the curriculum.

Early in the study it was decided that no consideration should be given to methods of teaching the material. It is true, of course, that methods of instruction do affect the content of a course, but they do not influence the raw material derived from the activities of the vocation. They merely affect the illustrative material and connective tissue. No consideration is given, for example, to the relative merits of laboratory, lectures, and textbook instruction. These are matters which concern the teacher. It was felt that a valuable contribution would be made if merely the raw material of the curriculum were derived from pharmacists' activities.

Completely to perform the task of curriculum construction, it is necessary to organize the raw material into teaching form, use it with the class for purposes of evaluation and consequent modification, and thereafter release it for national use. Such a task is, however, so enormous and requires the collaboration of so many authors, that it was decided to present only the raw material—the minimum essentials—and leave their organization to the voluntary desires of those authors who wish to prepare textbooks based upon the findings of the study or to revise those now in use. Already authors have made use of the material for the revision of existing texts and others have requested permission.

When the raw materials are organized into courses, it will be found necessary to add what is known as connective tissue—material which is not necessary directly to the pharmacist but is necessary in order that he may properly understand what he does need directly and to give the material logical consistency of organization. Here, again, the report confines itself to the presentation of raw material and leaves the inclusion of connective tissue to the instructor. The findings do not, therefore, constitute the whole content of the course; they are rather the minimum essentials of the course.

A careful reading of the report will reveal the fact that some studies are carried to greater completeness than others. In some cases, as in dosage, it would be a matter of mere duplication in material found in good form elsewhere to include the content in the report. In other cases, as in botany, it was thought to be sufficient to present vocabularies with frequency of use. In the case of chemistry, the opportunity was seized to have the raw material of the subject organized with its connective tissue into a systematic presentation of pharmaceutical chemistry. This is presented as an example of a functional chemistry based upon the findings of the study and

organized by one expert. Another expert might, of course, organize it in a different manner and use other connective tissue.

No attempt has been made to estimate accurately the length of time it will take to complete a college course in pharmacy. Yet, if the student is to receive a cultural training and adequate instruction in both commercial and professional pharmacy, the length of time would probably not fall far short of the four years.

### Skill in Pharmaceutical Practice.

The foregoing section deals with the information and processes that are necessary to the pharmacist in the intelligent prosecution of his activities. There is, however, a difference in the amount of skill that he needs in the mastery of the processes and information. If, for instance, the pharmacist is supposed to perform biological assays as a routine part of his business, he will require one degree of skill. If he merely masters the information about how biological assaying is performed, a much lower degree of skill will be required of him. The amount of skill needed in the degree of mastery of the information for practical purposes has in consequence a direct bearing upon the length of time devoted to the subject.

With this point in mind, the attempt has been made to state in connection with each of the topics in the content report the amount of skill which in the opinion of the Advisory Committee is demanded of the pharmacist in the pursuit of his profession, and therefore, should in relative degree be demanded of the student in college.

The problem of skill has a bearing upon practical experience. The amount of practical experience required of students while in college varies from none to one-half time over a period of two years. It appears to the committee that skill will be developed more rapidly and more intelligently if some practical experience is required under properly controlled conditions. It is recognized that beyond a certain point practical experience ceases to be educative and that a small amount of practice properly administered is superior to a very large amount without administration or supervision. Recommendations have, therefore, been made about the proper controlling of practical experience which should be included in the program of colleges of pharmacy.

### Pharmacy a Profession, Not a Trade.

After a careful study of the pharmacy curriculum with an open mind for a period extending over more than two years, the director of the study is definitely convinced that pharmacy is a profession rather than a trade. The materials that the pharmacist deals with are in many cases so dangerous in their effects upon physical well-being and the problems that face him in the handling of these materials and in his contacts with the public require so much intelligence —if they are properly performed—that it is absolutely essential for him to have a rather wide and intimate acquaintance with the fundamental sciences upon which the art depends; and since the distinction between the trade and the profession lies essentially in the fact that the trade needs to know only the methods in order to be proficient while the profession needs to know the principles upon which the methods depend, it follows that pharmacy is a profession rather than a trade.

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## THE SCIENTIFIC BASIS OF GALENICAL PHARMACY.*†

### By Professor A. Tschirch.

In the guiding principles for the revision of the Swiss Pharmacopœia which I laid before the Pharmacopœia Commission in 1922, some thoughts were developed with regard to galenicals, in the preparation of which time had brought but few changes. In the course of a century only one new method of preparation, that of percolation, had been introduced. Everything else had remained much about the same. I particularly emphasised the fact that the preparation of the extracts should be subjected to a renewed study, that the long neglected use of fresh plants for that purpose should again be brought to the front, but that no new processes should be adopted without being tested by pharmacological-clinical methods. These principles were adopted by the Pharmacopœia Commission.

Since the basis of all galenical pharmacy that has any pretension to being scientific is the chemistry of the medicinal plants, this branch of knowledge must be subjected to renewed study and even a step

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further back must be taken and investigations made on the composition of the fresh material and the changes it undergoes on drying. That of course can be done with such plants as grow or can be cultivated locally, but not with those that are imported in the dried state only. But the first step in the new direction meets at once with difficulties, as but little is known of the pharmacologically active substances that exist in the living cell. Nevertheless, it may be assumed that they exist primarily in a colloidal form, as it is generally accepted that the arrangement of atoms and molecules in a crystalline form is to be regarded as a final stage. Life is carried on by means of colloids. The discovery and isolation of these "primary colloids" as I have termed them, is, however, no easy task. The chemical methods of today are much too crude and only in a few cases has it been possible to obtain any clarity on the subject. It may, for instance, be accepted as certain that fixed oils do not exist in the cells in the free condition but always in the form of an oil-plasma which is easily dissociated, water being sufficient to effect this. Alkaloids too, in many cases, are not formed as such in the living cell but appear in the shape of alkaloidal tanno-glucosides which undergo partial decomposition when, on the death of the cell, the permeability of the plasma membrane changes and the acid cell sap enters. This decomposition of the primary colloids with liberation of the free alkaloid which enters into combination with the acid of the cell sap, is, however, not complete, for experiment has shown that the action of mydriatic drugs is not in proportion to the amount of alkaloid contained in them, but weaker. From this fact the conclusion may be drawn that in the case of alkaloidal drugs it is not only unnecessary but undesirable to retain the primary colloids unchanged and that a separation of the alkaloids should be aimed at. The method adopted in preparing purine drugs for the market shows how this may be done. In most of such cases the drug is fermented, that is, the decomposition of the primary colloid by means of the enzymes naturally present is artificially induced. If, then, we wish to obtain active preparations from alkaloidal drugs we must not endeavor to prevent decomposition of the primary colloid but on the contrary to induce it and obtain complete separation of the alkaloid, which must then be protected as much as possible from further decomposition during the manipulations to which the drug is subjected. In the case, therefore, of alkaloidal drugs the use of the fresh plant is not absolutely necessary.

With drugs containing glucosides the conditions are different. In such cases the primary colloid should be retained as such. Pharmacological tests applied to extracts of fresh Convallaria and Adonis show that their action is notably stronger than that of extracts made from the dried plants; the latter are often quite free from activity and accordingly have fallen into discredit. I have therefore proposed that with all medicinal plants containing glucosides as their active principles the preparations should be made with the fresh plants if these are available. Pharmacists would thus be encouraged to grow the plants for their own use and make the preparations from them.

But the simple requirement that the preparations should be made from the fresh plants is not sufficient. A method of protecting the glucosides from change must be devised as these substances are distinctly less stable than the alkaloids. One of the principal agents in their decomposition is enzyme action and therefore the fresh plants must be stabilised before they are extracted, and they should be as little cut up as possible. Kola seeds should be whole, gentian root in large pieces, and wormwood, Convallaria, and Adonis in bundles when exposed to the action of boiling alcohol, and extraction must follow stabilisation and grinding. If the fresh plants are crushed before they are stabilised a more or less profound decomposition of the primary colloids will take place and this will be still greater if the juice is pressed out and treated, as then the enzymes will at once develop their activity.

But the process of making a medicinal preparation from a member of this group is not completed by extraction with a suitable menstruum. For the last hundred years it has been the practice in pharmacy to evaporate the liquid on a water-bath to an extract with the result that the more the liquid was evaporated the greater the proportion of decomposition products it contained. In the guiding principles already alluded to, I have recommended that thick extracts should be entirely discarded and only liquid extracts and dry extracts retained. Even in making these the active constituents should be protected from change. The use of a vacuum should be compulsory both for extracts containing alkaloids and those containing glucosides.

Of the two types of extract, *viz.*, the liquid and the dry, the dry are certainly the more stable, for there can be no doubt that further changes in liquid extracts are possible even if they have been sterilised by heat and that such changes will not take place at all or only to a less extent in the dry extracts. Comparative experiments, how-

ever, have shown that such changes are only slight; it is during the drying of the drugs by the usual methods and the evaporation of the extracts that the most far-reaching changes are produced.

The proposition has also been made that the drugs themselves should be sterilised, that is, that the action of the oxidases, hydrolases, etc., on the primary colloids, which I described at the Eleventh International Congress at the Hague in 1913, should be prevented.

There is no objection to stabilising drugs, though the process would probably increase the cost considerably and it might be unnecessary if the drug is dried rapidly, at as low a temperature as possible, and with the use of an aspirator. Stabilisation cannot, however, take the place of preparation from the fresh plant, which is the method I prefer whenever possible, that is, when fresh plants are available. Nevertheless, with certain drugs stabilisation should be tried.

Further changes will inevitably take place in stabilised drugs and also in stabilised extracts made from fresh plants. Processes of auto-oxidation will certainly play an important part in such changes. Against these we are practically helpless. We do not, for instance, possess any means of protecting oil of turpentine exposed to light and air from resinification, that is, from auto-oxidation, and we cannot prevent tinctures from ageing. The only thing we can do is not to prepare quantities that are too large and to renew the stock frequently. For while we can delay changes in some galenicals by means of buffers, as, for example, Spiritus Ætheris Nitrosi, Oleum Phosphoratum, etc., and can require that others, such as Hydrogenium Peroxydatum, be prepared extemporaneously, we cannot employ these means in the case of extracts of drugs—at least, the experiments that I have been carrying on for a long time have not led to any final results of general applicability. We must content ourselves with excluding the action of enzymes and light. The studies on auto-oxidation have, however, led to important results in other directions. A study of the auto-oxidation of fats and oils has disclosed the conditions governing the auto-oxidation. This process leads to the formation of substances (aldehydes and ketones) which may decompose drugs that are mixed with them, and the investigation has shown how these changes may be opposed. Light, air, water, the presence of fat acids with double bonds, and, in a few isolated cases (coconut oil and butter), of moulds and micro-organisms play an important part. I had hoped, by converting the unsaturated fat

acids into saturated, to remove the weak point, and attempted by hydrogenising oils to obtain fats containing but small quantities of fat acids with double bonds, as there is no doubt that the double bond is the vulnerable spot. But the fats so obtained, with an iodine value as low as 2, were too hard to serve as ointment bases, although they did not decompose potassium iodide when kept in contact with it for months. As the unsaturated fat acids cannot be removed, nothing can be done but exclude light and air as much as possible, drive out any moisture by heat (which also sterilises the lipases), remove the last traces by exsiccated sodium sulphate, and fill the hot fat into light-proof, well-closed earthen pots. Such fat can be well used as an ointment basis, as it does not become rancid and does not produce substances that would decompose added drugs or have an irritant action.

A few more words concerning tinctures. The idea underlying the tincture is that of the "quinta essentia"—that is to say, by means of extraction, ballast, consisting mostly of the cell walls, etc., is got rid of. But the tincture also contains ballast, and the removal of this is one of the problems of modern galenical pharmacy. I have endeavoured to solve the problem in the case of tincture of rhubarb, and have succeeded in preparing a pure laxative by removing the astringent tannin, which is antagonistic to the laxative anthraquinones, by means of hide powder. In this case the conditions are clear, but they are not always so. We do not always know what substances are simply ballast and what are useful adjuncts. In such cases caution must be exercised and the point decided by pharmacological-clinical experiment.

The study of the scientific basis of galenical pharmacy offers many opportunities of improving the methods of preparation, and leads us to a period which may be described as that of protective methods, which are being more and more employed in biochemistry. As, however, the clinical experiments have been carried out with preparations made by the old methods, it is essential that those made by the new method should be subjected to similar testing before they are introduced into practice. An extract made from fresh male fern, fresh Convallaria, or fresh Adonis by the new method is much more active than one made by the old, and, under certain circumstances, might lead to cases of poisoning. Preparations made by the new method are different pharmacological individuals from those made by the old.

There is much promising work to be done in the field of scientific galenical pharmacy—a field which should be cultivated by the practical pharmacist in conjunction with the physician. The case is not one of simply making a preparation that tastes well, keeps well, and mixes well.

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## THE LOST ARTS.*

**By William Edwards Henderson.**
**Ohio State University.**

Those who are not so optimistic may think that public speaking and teaching should head the list of the "lost arts."

There have been many implications that the present civilization has lost some of the practical achievements of the ancients. It is not my purpose to belittle their accomplishments, but I will endeavor to point out that they did nothing which we cannot achieve, or had nothing which we cannot have, if we so desired.

Wendell Phillips in the thirties and forties delivered a lecture on the "lost arts," more than two thousand times. Phillips obtained much of his information from Pliny's History and did not critically analyze such information. He also stated that when we wanted high-grade steel for watch-springs (*e. g.*), we obtained it from the Punjab of India and not from the Sheffield factories. The column at Delhi, which is still standing, is mute evidence of the production of a very pure iron.

The methods used in making iron at that time were favorable to a high-grade product. Labor was cheap and the makers used hand-picked iron ore which in itself was free from phosphorus, silicon, and sulfur. The ore was treated with pure charcoal and all of the working was done by hand. This art was never lost but had to be abandoned as it did not meet the demands after gunpowder was introduced. This larger demand threatened deforestation in places and Britain passed laws prohibiting the use of charcoal for this purpose. The manufacturers turned to coal which contains sulfur and other impurities. Centuries were required in learning how to make high-grade steel in large quantities from ordinary ore and coal. It was cheaper for London to obtain a few pounds of high-grade steel

*Reprinted from *Ind. & Eng. Chem.*, News Edit.

from India for making watch springs, pinions, pivots, bearings, etc., than to induce Sheffield to produce a small batch of it.

The hardening of copper is often spoken of as a lost accomplishment. The use of iron as a material for implements parallel the copper age and in some localities it preceded the bronze age. Homer's Iliad tells us that copper was hardened by heating and plunging it into water. We know that copper is actually softened by such a process, hence Homer apparently meant iron. The people of 2500 years B. C. knew how to harden copper by the addition of tin and what they really obtained was an alloy. The ancients cut granite blocks for the pyramids with copper saws and because of this later peoples assumed that the saws were of hardened copper. As a matter of fact a soft copper saw fed with emery dust may be used in such cutting.

According to Pliny, the ancients made elastic glass which could be dented and straightened out again. Pliny exercised care in handing down this information as he merely relates a story which says that a workman came to the emperor and offered to make it. The emperor had the man decapitated as he desired to preserve the value of his gold and silver vessels.

The iridescent glass of the ancients is often spoken of as a glory of the past. Many poor glasses with the soda washed out by usage and the silica deposited in laminations act as ruled gratings occasioning interference colors. It is not at all uncommon to find an old cheap bottle buried in the soil that will show the same beautiful coloring. Tiffany's iridescent glass may not be as beautiful as some of these ancient glasses but it is of a much better quality and is iridescent as soon as made. The Egyptians, about the time of the birth of Christ, did crude glass molding by softening a glass rod wound on a model and welding it by tapping it with a hammer while in the plastic state. All of their glass jugs and other vessels were opaque. Checkered and mosaic glass can still be made providing the time-labor factor is sufficiently large, but we no longer expend such a large amount of time.

Certain cathedrals, notably the Cathedrals of Chartres and York, witnessed the highest stage in the art of stained glass. This glass was all made locally and often several centuries were required in its making. The makers couldn't duplicate any two batches. Small quantities were obtained and these were mottled, streaky, wavy, and of varying thickness. A great artist assembled these quantities, picked

over them, and worked out the modulations and designs for the various windows. A lifetime was required for such assembling. In that age the window openings were high and small and the rooms dark, all of which aided the sparkling brilliancy of the glass windows. The windows of today are lower and wider and we are inclined to use softer colors.

What we have lost is the genius that works out great designs and spends a lifetime in assembling it.

Another reputed lost art is the beautiful blue glazes of ancient Japan. The Japanese have consulted Professor Edward Orton to learn the controlling of their own blue glazes. The Japanese made many oven batches and afterwards sorted out sets from many hundreds of pieces. These uncontrolled and merely accidental glazes were dedicated to the Gods and handed down in temples.

It is said that the old Romans made and used paint pigments which are just as beautiful today as the day of their application. It is a physical chemical fact that a solid pigment which absorbs light is either oxidized or reduced and known as faded. These paintings and mural decorations have been preserved in darkened rooms and those originally exposed were covered and rejuvenated. The colors in Nero's crypt really look somewhat dingy. The pigments in the rocks of Arizona would be just as permanent on our walls but we don't want them.

The old Roman cements have also enjoyed a glorious history in that even though the rocks have dissolved away, the cement skeleton still remains. Analysis shows that these cements were high in lime, dirty, and full of volcanic ash. By the law of chance some of the batches of cement were good. Some of the specimens washed away. We have submitted some of these remains to modern structural tests, such as crushing strength and have found them wanting. How much of this material was the product of art and how much of chance?

The wonderful Egyptian embalming is constantly cited as indicating highly specialized knowledge. Any man dying in the Arizona and left alone becomes a perfectly good mummy. The Egyptians removed the viscera from the body, and wrapped the remains in many yards of cloth impregnated with asphaltum, tars, and waxes. The latter protected the body from the ravages of the air thereby preventing decay.

In that age many of the people were slaves and were obliged to dedicate their lives to the two or three occupying the highest places.

Today we have a democracy as against the aristocracy of then. Which is the better? There is no hidden knowledge but instead knowledge has pyramided. To a considerable extent we have lost the spirit of sacrifice behind it. The belittling of the present generation helps us glorify our ancestors and ancestral worship is not entirely a lost art. The defeated of two boys in combat is still known to reply, "What if you can lick me, my father can lick yours."

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# MEDICAL AND PHARMACEUTICAL NOTES

THE HEN'S BODY TEMPERATURE.—It is a rather curious fact that a hen's temperature varies through a range of several degrees within the short space of twenty-four hours, and that this variation follows a quite regular process not only throughout the twenty-four hours, but from day to day and month to month.

The average temperature of normal hens varies all the way from 104.6 to 109.4 degrees Fahrenheit, as shown by one series of observations, depending upon the time at which the temperature is taken. These temperatures are rather high as compared to large animals and to man.

There seems to be no significant difference between breeds. The chicken has a lower average temperature, however, than the pheasant, pigeon and guinea hen. The average body temperature of the hen is above that of the turkey and the goose.

When temperatures were recorded every two hours from six in the morning until ten at night it was found that the highest temperature for the day was reached between noon and four o'clock, whereas the lowest temperature occurred late at night. The daily variation for individual birds ranged from 1.6 to 4.8 degrees Fahrenheit. These observations were all made at Cornell University.

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ANIMAL INCREASE HELD DUE TO SUN REGULARLY CHANGING ITS SPOTS.—Many million miles separate the spots on the sun from a rabbit, but scientists declare that there is a connection between them, and that the periodic changes in the number of dark masses on the sun's surface partly explain certain facts concerning the growth of

plants and animals. Records of the spots have been kept for 150 years, and it has been found that they increase to a maximum about every eleven years. This high point is accompanied by a low-temperature period on the earth, it is said, while fluctuations in atmospheric pressures, rainfall, tracks of storms in North America and the rate of growth of the redwood trees are all declared to correspond to the changes in the sun-spot numbers. Records kept by the Hudson Bay Company since 1845 are said to show that the number of rabbit skins received reaches a high mark at a time when the sun spots are at a minimum. The sunlight is believed to have a direct influence on one of the vitamins in the food the animals eat and thus affect their numbers. Due to a climate fluctuation of unknown cause, every three and one-half years, a small arctic animal, known as the lemming, attains vast numbers and hordes of them migrate to the lowlands, and even into the sea, dying by the thousands as they plunge into it.

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PHARMACY IN DENMARK.—Danish pharmacists occupy a privileged and esteemed position in the community. At present there are in Denmark about 300 pharmacies, of which approximately eighty are owned outright by persons or firms. The remaining 220 shops are State owned, being given as lifetime grants to certain privileged persons. These pharmacies of course cannot be sold by the holder of the grant, nor claimed by heirs in the event of his death, in which case they revert to the State for regranting.

Permission to purchase and operate a privately owned pharmacy must be obtained from the Government. With a few exceptions only licensed pharmacies are permitted to sell prepared medicines. Furthermore, all preparations containing narcotics or other drugs to a degree considered dangerous to the health can be sold only through a doctor's prescription, and sales are closely controlled to guard against improper use of the prescription. The standard pharmacopœia in Denmark is the Pharmacopœia Danica, but the United States Pharmacopœia and the British Pharmacopœia are also known and are used to some extent in the compounding of medicines according to foreign formulas. There are also several semi-official publications dealing with the methods of preparing medicines, which are used to a considerable extent.—(Abstracted from a *Department of Commerce Bulletin.*)

Oil of Orange in Commerce.—For the past few years the annual consumption of oil of orange in France has approximated 350,000 pounds, of which about 90 per cent. is supplied by Italy with lesser amounts coming from Spain and elsewhere. The Italian oil is especially esteemed by the French manufacturers for the reason that it blends unusually well with other oils and also retains its strength exceptionally well. France consumes about one-half the total Italian production. The Spanish oil of orange is claimed to be of better grade than the Italian, but the French consumers insist that the Italian oil is satisfactory for their purposes and apparently have but little interest in the Spanish oil. Oil of orange is used in France in perfumes, candies and other sweets, wines, and liquors, and in various pharmaceutical preparations, and while no estimate can be made of the amount of oil entering into the production of any of the above it is considered that they rank in about the order given. American oils are not much used by the French, it is stated, because their qualities are not as well suited to the perfume industry as are the Italian, and, in addition, there is an additional bar to American oil created by the French tariff schedules which, because of special treaties, are lower in the instance of Italian oils than the American.

—(*Commerce Report.*)

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The Crude Drug Market at Trieste.—Trieste may be denominated the crude drug market for central Europe and might also be said to bear something of that same relation to the producing areas in the Near East. Added to its favorable geographical position is the matter of its terminal facilities, both for rail and water transportation, and the fact that it is virtually the only seaport for Austria, Hungary, Jugoslavia, and parts of northern Italy. In Trieste, too, many old and well established dealers in crude drugs maintain their headquarters whence they both import and export. The Trieste market is utilized to a considerable degree by American consumers of crude drugs and especially those who buy in small quantities.

With the exception of pyrothrum flowers, practically the entire supply of crude drugs results from the efforts of the peasant population which gather the drugs from the uncultivated plants. This operates to render the supply very unstable, as prices will frequently fall below a point which will entice the peasant to leave his farm to gather the wild herbs. The fact that most of these drugs so gathered are dried in the open air adds another element of uncertainty to the

supply, as unfavorable weather conditions during the ripening and drying seasons often materially affected the quantity and quality of the product. Most of the crops begin to enter the local market in July and continue until the latter part of November. Flowers enter first, to be followed by leaves, roots, berries and seeds.

—(*Commerce Report.*)

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A Natural Hybrid Foxglove.—In a recent communication to the French Academy of Sciences, Goris and Metin reported the occurrence in *Aconitum anthora* of an alkaloid to which the name "anthorin" was given, which is physiologically antagonistic to aconitin. They now report that in a certain district in France, hybridization occurs spontaneously between *A. napellus* and *A. anthora*, and numerous examples being found but limited to a small area. The general morphologic features, especially as regards the leaves, are nearer to *A. napellus* than to the other species. The microscopic structure, on the other hand, is closer to *A. anthora*. On chewing the leaves, the peculiar tingling sensation of the leaves of *A. napellus* is not noticed. Goris and Metin transplanted some of the plants to a suitable garden and at a favorable time collected portions. From that they obtained a mixture of alkaloids amounting to 0.015 per cent. The amount not being enough for chemical examination and separation, physiologic tests were employed. Introduction into the experimental animal of a dose sufficient to produce serious symptoms if the material consisted wholly of aconitin was without noticeable effect. On the other hand, introduction of such amounts as corresponded to the lethal dose of anthorin produced early death with symptoms of both alkaloids. The material used in the experiments produced a tingling sensation on the tongue, although this, as noted above, was not observed directly on the plant tissues. The proportions of the alkaloids characteristics of each parent plant may differ in the different specimens of the hybrid, but it seems to be proved that each hybird contains some of the alkaloid of each parent. (*Rep. d. Pharm.* [3], 1925, *36*, 173.) H. L.

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Wood Alcohol in Bootleg Liquor.—Notwithstanding that analyses have demonstrated that wood alcohol is but rarely present in bootleg liquor, those having a predilection for the consumption of

such wares have a wholesome and everpresent fear of encountering this poison, and many and amusing are the schemes that have been proposed for its removal. For such purpose ordinary distillation will not serve, much less any process of absorption or filtration.

Yet there have been those who have claimed to be able to turn the trick by means of such absurd devices as squeezing the liquor through cotton waste or soaking through a loaf of bread. Recently we had brought to our attention, by a health officer, a grayish powder, sold without label and said to be now offered through New England for this purpose, the claim being that shaking the liquor with some of this compound serves to remove every trace of any methyl alcohol present. The analysis indicated it to be merely an over-charred bone-black, and about as effective for the purpose as water for kindling a fire. The scheme is however well in keeping with the ignorance and credulity of the general public with respect to the manufacture, composition and adulteration of intoxicants.—*Health* (*N. H. State Board*) *Bulletin.*

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Glycerin as a Radiator Compound.—Professor Keyes, of the Massachusetts Institute of Technology, who has had a large experience both in operating his own car and in supervising the operation of a fleet of trucks belonging to a company of which he is an officer, expresses entire confidence in mixtures of glycerin and water as anti-freeze liquids. Professor Maxwell, of the University of Alabama, also holds this opinion. Commercial glycerin may, however, be contaminated with fatty acids and therefore corrosive. A distilled article is now in the market, which is free from corrosive impurities, and will be furnished ready for use, the proportions of water and glycerin being adapted to the special use. The particular advantage that glycerin possesses over alcohol is that there is no appreciable loss by evaporation. In addition, the present legal restrictions on the sale of alcohol even when denatured are entirely avoided. The glycerin liquid is more expensive than the other solutions now in use, but only one filling is needed for the whole winter season, thus making the cost per season less than that of other methods. The solution will be marketed in containers. It has a boiling point not markedly above that of water, and on the other hand a freezing point much lower. H. L.

# SCIENTIFIC AND TECHNICAL ABSTRACTS

DETERMINATION OF POTASSIUM AS ACID TARTRATE.—R. Meurice describes in *Ann. Chim. Anal.*, etc. (2) 1925, 7, 161, a procedure in which advantage is taken of the sparing solubility of acid potassium tartrate, but instead of weighing the precipitate, it is titrated with standard acid after over-neutralizing it with standard alkali. The precipitant is acid sodium tartrate dissolved in a mixture of equal parts of pure methanol and water. Methanol of high purity and almost absolute can now be obtained in abundance and at reasonable rates. If sulphates are present sodium sulphate will separate, but as this is neutral it will not interfere with the determination by titration. After obtaining the precipitate of acid potassium tartrate, and decanting the liquid through a suitable filter, it is washed with the methanol-water mixture until a few drops of the filtrate give no appreciable precipitate with a concentrated solution of potassium acetate. As is well known, the separation of acid potassium tartrate is promoted by stirring, which should not be omitted. It is advisable not to use more than 100 cc. of the washing liquid, divided into as many small portions as possible. After washing, the filter and contents are placed in the beaker containing the rest of the precipitate, over-neutralized by standard sodium hydroxide, and the excess of alkali determined by titration with standard acid. Test analyses with samples containing sulphates, nitrates and chlorides, as well as magnesium compounds showed approximations to about 0.5 per cent. of the amount present. To insure the complete precipitation of the acid potassium tartrate, it is necessary to stir the liquid well and even to allow it to stand over night. The procedure is recommended for the analysis of fertilizers. H. L.

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PERCHLORIC ACID AS AN ANALYTICAL REAGENT.—Professor John H. Yoe, of the University of Virginia, reports several important applications of this substance. Analogy would suggest to most chemists that it would be easily decomposed, indeed, it would be regarded as dangerously explosive. It is, however, about the most permanent of the chlorine-oxygen series. Its aqueous solutions can be boiled without decomposition. Moreover, the dihydrate is a power-

ful desiccating agent. The sparing solubility of its potassium salt has long been known. As early as 1831, Serullas proposed it for determination of potassium, but his suggestion did not meet with immediate acceptance. When hot the acid is a powerful oxidizing agent on a great variety of organic substances such as gelatin, casein, blood. It is now being used in the laboratories of the University of Virginia for dehydration of silica, Kjeldahl procedure and determination of potassium. The details of these procedures are given by Professor Yoe in a communication to the *Ann. d. Chim. Anal. et Appl.* [2], 1925, *7*, 193, from which this abstract is taken. The applications to silica dehydration and nitrogen determination were originally described by Willard and Cake, *J. A. C. S.*, 1920, *42*, 2208, and Mears and Hussey, *J. I. E. C.*, *13*, 1054. The manufacture of perchloric acid by the electrolysis of hydrochloric acid was the subject of a patent issued in the United States (1,271,633) in 1918, to E. Walker.

The perchloric acid indicated in the procedures is of 60 per cent. strength, a grade that is now easily obtained in the market.

*Determination of Potassium:* The presence of sodium salts does not interfere with this procedure. The principle of the method is extraction and not precipitation, being based on the insolubility of the potassium salt in strong alcohol while the sodium salt is soluble. Heavy metals must not be present, a condition that is usually attained without difficuly in ordinary analysis. The sample for analysis should be so treated as to have only sodium and potassium salts present. About half a gram is dissolved in the minimum amount of water, to a clear solution. Add 1 cc. of perchloric acid and evaporate the mixture to a sirupy condition. Cool, add 15 cc. of water and 2 cc. of the acid and again evaporate. Add to the residue 15 cc. of water and evaporate until heavy vapors of the acid cease to appear. Cool completely, add 20 cc. of 97 per cent. alcohol containing 0.2 per cent. by weight of the acid, stir for five minutes in order to obtain a coarsely granular condition, allow to settle, decant through a tared gooch crucible, wash with a limited amount of the acid-alcohol, pour 20 cc. of the same on the mass, stir, allow to settle, decant and remove the alcohol by evaporation. Dissolve the residue in 15 cc. of warm water, add a few drops of perchloric acid, and heat until fumes of this appear, cool, add 1 cc. of the alcohol-acid mixture, decant and evaporate a few drops to dryness. If a residue remains the process of extraction must continue until the decanted alcohol-acid no longer dis-

solves an appreciable amount of substance. Finally, treat the residue with 1 cc. of the washing solution, transfer the salt to the gooch and wash with 2-3 cc. of pure 97 per cent. alcohol, dry for forty-five minutes at 130 degrees C. and weigh. The compound is, of course, potassium perchlorate. The error is only from 0.2 to 0.3 per cent. if the procedure is carefully carried out. It is not tedious or difficult, and avoids the cost of the platinum method.

*Determination of Nitrogen:* Mears and Hussey, as noted above, first worked out the application of perchloric acid as an oxidant in the Kjeldahl method. Professor Yoe has employed the method for four years in the students' laboratory at the University of Virginia, for analysis of egg and blood albumins, dried blood and gelatin. The procedure is as follows: Transfer exactly a weighed portion, about 2 grams, of the sample to a 500 cc. digestion-flask, add about 0.5 gm. copper sulphate, 25 cc. of sulphuric acid (1.84) and 2 cc. of perchloric acid. Heat as usual under a hood, taking care that the flame does not strike above the liquid. Decoloration will usually occur in about five minutes but the heating should be continued for fifteen minutes longer. The determination is then finished in the usual manner. Careful experiments by Yoe have shown that the process thus modified loses none of its accuracy. H. L.

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Composition of Fermentation Gases.—In his classical experiments on alcoholic fermentation, Pasteur had found out that the gas escaping during the course of that fermentation was composed of more than carbonic dioxide. He had obtained a residuum that, to his mind, was nitrogen. Numerous chemists who had taken up these researches had not endeavored to obtain the composition of this waste gas.

M. Pictet, together with a few associates, experimented with alcoholic fermentation from which he carefully kept any air, and in the fermentation gas he observed the presence of a small quantity of argon which was identified by the spectrum. This is a phenomenon unaccounted for, since every precaution had been taken. M. Pictet, having used potassium salts as nutritive agents, sets forth the hypothesis of disintegration of radioactive potassium, which disintegration would have produced the argon.

This disintegration of a metal, by means of a biologic process offers an interesting research problem.—*Jour. Ind. and Eng. Chem.*

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**The Lectures Will Begin at 8.15 P. M. and End by 9.30 P. M.**

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**First Lecture** **Thursday Evening, October 8, 1925.**

### THE FLIGHT OF A BALL THROUGH THE AIR.

**By George Rosengarten, Ph. D.**

**Instructor in Physics, Philadelphia College of Pharmacy and Science.**

This problem is an all-important one, entering as it does into the various sports in which we all engage. Baseball, Golf and Tennis in particular will be considered. From the moment that the ball leaves the pitcher it is acted upon by inanimate forces until it is struck by the bat, when a combination of physical and physiological forces react and send the ball in the opposite direction.

What is the cause of a curve ball? Where is the best place on the bat to hit the ball? Why is it necessary to have a standard ball? These questions and many others will be carefully considered from a scientific point of view. Experiments and charts will supplement the lecture so that all may understand the operation of the forces of nature which play so important a part in our national game of baseball.

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**Second Lecture** **Thursday Evening, October 22, 1925.**

### THE DIAMOND AND ITS COLORED BRETHREN.

**By Freeman P. Stroup, Ph. M.**

**Professor of Chemistry, Philadelphia College of Pharmacy and Science.**

It seems to be a far cry from milady's diamonds to the polish used on the kitchen range, or from the material used to clarify sugar solutions to the grease in the crankcase of an automobile; but these and many other articles of more or less general use owe their value.

wholly or in part, to some form of carbon. This lecture will deal with carbon in its varied forms, and an attempt will be made to cover, in non-technical language, the important utilizations of these. The lecture will be illustrated.

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**Third Lecture** **Thursday Evening, November 5, 1925.**

### ENVIRONMENT—THE BIG FACTOR IN HEALTH AND DISEASE.

**By Louis Gershenfeld, B. Sc., Ph. M.**

**Professor of Bacteriology, Philadelphia College of Pharmacy and Science.**

The old idea of heredity as the cause of many of the diseases afflicting mankind, is no longer tenable. However, this is still one of the many false and misleading views held by the laity. Environmental conditions are the big factors that produce an abnormal state of health. The injury they cause cannot be accurately measured. It is our environment which affects our standards in regard to what we think is beautiful and healthy. If we wish to enjoy living, it is our duty to be active in the everlasting campaign against disease. With a better understanding and appreciation of our exact knowledge, preventive measures can be carried out along more intelligent and useful lines.

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**Fourth Lecture** **Thursday Evening, November 19, 1925.**

### MORE ABOUT COLOR AND COLORS.

**By J. W. Sturmer, Ph. M., Phar. D.**

**Dean of Science, Philadelphia College of Pharmacy and Science.**

Many things in nature which exhibit color, contain no coloring matter. Such color effects, usually spoken of as "structural colors," are shown by certain rocks and precious stones, by bird feathers, by insect wings, and by many familiar objects. The lecture will be illustrated with material from many sources,—some from the Philadelphia "Zoo."

**Fifth Lecture** **Thursday Evening, December 3, 1925.**

### THE ROMANCE OF MEDICINES.

**By Charles H. LaWall, Ph. M., Sc. D.**
**Chemist to Food Bureau, Pennsylvania Department of Agriculture; Dean of Pharmacy, Philadelphia College of Pharmacy and Science.**

Many of the popular remedies which are more or less widely used and known to the laity have had romantic or dramatic origins, and interesting histories. One popular remedy of a century ago, still occasionally used, was called Vinegar of the Four Thieves, because a band of robbers during one of the plague epidemics in France, used it as a prophylactic against disease.

In like manner such common remedies as Seidlitz Powders, Blaud's Pills, Cold Cream, Dover's Powder, Fowler's Solution, Friar's Balsam, Laudanum, Paregoric and many others have a tinge of romance or of tragedy in their history. The lecture will be illustrated with lantern slides and specimens.

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**Sixth Lecture** **Thursday Evening, December 17, 1925.**

### WHAT SHALL I DRINK?

**By Horatio C. Wood, M. D.**
**Professor of Materia Medica, Philadelphia College of Pharmacy and Science.**

From earliest historical times mankind has supplemented his food with various beverages, such as beer, wine, coffee, tea, etc. This lecture will cover the history of the use of these and some of the less known drinks, and also give an account of their effects on the body and the results of their habitual use.

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**Seventh Lecture** **Thursday Evening, January 7, 1926.**

### DELECTABLE CONFECTIONS.

**By E. Fullerton Cook, Ph. M.**
**Professor of Operative Pharmacy and Director of the Pharmaceutical Laboratory, Philadelphia College of Pharmacy and Science.**

The love of "sweets" is as old as the race, yes, apparently as old as animal life, for the ant and the elephant vie with man in ap-

preciation and delight of sweet things to eat. Our generation has lavishly provided the "good things" of earth, but probably in no field so abundantly as in that of confections.

Not only are candies of today unrivalled in variety, attractiveness and cheapness, but the sanitary condition of the factory and the purity and digestibility of the product made in the United States exceeds anything heretofore considered practicable.

The story is almost as fascinating as the "chocolates" themselves and the alluring odors of the factory can almost be sensed as one sees, even by picture, their production on a gigantic scale.

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**Eighth Lecture** **Thursday Evening, January 21, 1926.**

### SOME THINGS NOT OFTEN SAID ABOUT MILK.

**By David Wilbur Horn, Ph. D.**

**Professor of Physics and Physical Chemistry, Philadelphia College of Pharmacy and Science; Professor of Inorganic Chemistry, Wagner Free Institute of Science.**

What is usually said about milk has been said over and over so often that it is timely and profitable to depart from this custom. Milk is not as yet well understood; a start has been made in its physiology and pathology, the physical chemistry of milk is in its infancy, the bacteriology of milk is advanced as far perhaps as early adolescence. It is one of the profoundly significant factors in mammalian life, and it lends itself more readily than the others to sophistication and misrepresentation. To be ignorant and indifferent concerning milk is a crime against self, offspring and fellow,—a crime punishable in many instances by torture, suffering and death.

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**Ninth Lecture** **Thursday Evening, February 4, 1926.**

### THE SIGN OF THE SKULL AND CROSS-BONES.

**By Ivor Griffith, Ph..M., P. D.**

**Physiological Chemist, Stetson Hospital; Assistant Professor of Pharmacy, Philadelphia College of Pharmacy and Science.**

What is a Poison? Some legal and scientific definitions. The Poisons and Poisoned of History. Poisoning was a fine art when Rome was Roman. According to the Eddyites it is still so today,

for the art and practice of medicine deal largely in poisoned potions to alleviate human ills.

Cultivating a tolerance for poisons, Poison myths and fallacies, different kinds of poisons, and their antidotes—all these subjects will be covered in the lecture. There will be shown much illustrative material and some lantern slides.

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**Tenth Lecture** **Thursday Evening, February 18, 1926.**

### THE SALT OF THE EARTH.

**By Edward J. Hughes, P. D.**
**Assistant Professor of Chemistry, Philadelphia College of Pharmacy and Science.**

Where is there a more useful and a more necessary substance than common salt? Because of their abundance in nature we are so apt to look upon such essentials as air, soil, water and salt as the common things of the earth. Yet the chemist has recently revealed that we are just beginning to learn something about the significance of salt. Man has been adding salt to his food for ages. Later on he began using it to preserve fish and meat. But it was when the little salt molecule was decomposed into a silvery white metal called sodium, and a greenish-yellow gas called chlorine, that men of science recognized salt as one of the treasures of the earth.

It has been shown that a close relationship exists between the history of salt and the history of man, and that the color of man is actually dependent upon salt.

Reference will be made in the lecture to the many industrial applications of salt, pointing out how it has been utilized in the frightfulness of war as well as in the commercial enterprises for the benefit of mankind.

The lecture will be illustrated with experiments, lantern slides, and specimens.

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**Eleventh Lecture** **Thursday Evening, March 4, 1926.**

### IMITATION OF LIFE.

**By Arno Viehoever, Ph. D.**
**Professor of Biology and Pharmacognosy and Director of the Botanical Gardens, Philadelphia College of Pharmacy and Science.**

A brief discussion of the meaning and essentials of life is to be followed by an account of the fruitless attempts through the ages to

create life (spontaneous generation) and of the success in copying important functions of living organisms. The aim is to demonstrate the progress made in imitating life, the present status and limitations and to conclude with a general outlook of the possibilities ahead.

The lecture will be illustrated with lantern slides and experiments.

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**Twelfth Lecture** **Thursday Evening, March 18, 1926.**

### ABNORMAL PLANT GROWTHS (GALLS).

**By Marin S. Dunn, A. M.**

**Assistant Professor of Botany, Philadelphia College of Pharmacy and Science.**

Galls are abnormal growth produced in plants by plant and animal parasites. They are of special interest to us because many are harmful to our ornamental and economic plants, because some are of benefit to us in tanning, dyeing, ink manufacture, as local astringents, etc., and because connected with them is the fascinating problem of abnormal plant growth. Wide in their distribution throughout the plant kingdom, curious in their form, strange in their history, plant galls are of never-failing interest. The lecturer will cover the following topics: (1) organisms causing gall formation; (2) structure of typical gall; (3) possible explanations of the origin of galls; (4) development of the gall; (5) benefits of the gall to the parasite; (6) injurious galls; (7) beneficial galls.

The lectures will be fully illustrated with specimens and lantern slides.

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**Thirteenth Lecture** **Thursday Evening, April 1, 1926.**

### THE WONDERS OF THE MICROSCOPE.

**By Henry Leffmann, A. M., M. D.**

**Lecturer on Research, Philadelphia College of Pharmacy and Science; Hon. Professor of Chemistry, Wagner Free Institute of Science, Etc.**

The microscope is probably the most exact instrument employed in research. A vast amount of theoretical study and high mechanical skill has been expended on its development and construction, and its services embrace every department of science. From the enormous

material available for illustration of the useful and impressive views revealed by the instrument, the lecture will comprise a selection of lantern slides adapted to show the variety of its applications. Incidental mention will be made of the so-called ultra-microscope adapted for examination of objects too small for detection by ordinary instruments.

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# BOOK REVIEWS

PHYSIOLOGICAL AND CLINICAL CHEMISTRY. William A. Pearson and Joseph S. Hepburn. 305 pages. Many illustrations. Lea and Febiger, Philadelphia. Price, $4.

"It is the sincere hope of the authors that this book will be of considerable value to their students and to other students and practitioners of medicine." This is quoted from the preface. The reviewer's reaction to the sentence is that the authors are altogether too modest in this expression of a hope. So well written is this handbook, so eminently practical is its arrangement, and so brimful is it of worthwhile information that it deserves a circulation much more expansive than is suggested in the preface. Chemists, teachers in the sciences, pharmacists and many others will find a wealth of information tabloided here, as one can seldom find in other similar works.

The usual defect with laboratory manuals is that they become too diffuse. A choice of too many tests is often afforded. To the student this is quite confusing. The authors here have generally given only those tests which, in their experience, are satisfactory and practical. The work shows an evident attempt to include not only the proven older tests, but also the more up-to-date laboratory practices, notably so in the chapters on Clinical Chemistry.

An aversion toward set tables is rather noticeable through the book. The factors and figures are "run in" throughout the text, as in the statement of breast milk constituents. This does not make for "readability." The authors in the chapter on water analysis venture to give permissible standards (limits) of impurities for potable waters. Academically this is not a risky thing to do, practically, however, there are many, many factors to consider before deciding upon any arbitrary limits. However, as one reads on to the interpretation

of tests there is recorded much additional information to further qualify the table referred to.

There are a number of minor defects in proofreading, such as *Million's* reagent, *m*itro-benzine, etc., errors which will be promptly rectified in a later edition.

On the whole the book, interleaved for student purposes, is eminently suited for its intended purpose, and it will find a very useful place in the library of laboratory technicians, teachers and other scientific workers.

IVOR GRIFFITH.

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OPERATING ROOM PROCEDURE. For Nurses and Internes. By Henry C. Falk, M. D. 275 illustrations, 385 pages. G. P. Putnam's Sons, New York. Price

There may be other books written on this subject, but there has never come to this reviewer's attention any that handles the subject as comprehensively and as modernly as his volume. Dr. Pool, in the foreword, states that it must be recognized that the nurse constitutes a very important cog in the wheel which drives a smooth-running operation. Her co-operation, skill and good will are usually taken for granted. She gathers her knowledge largely from experience which ripens as she notes the errors of herself and her colleagues. She ordinarily receives too little organized and systematic teaching as to operating room details to ensure safe and intelligent co-operation in her early efforts. The study of such a book as Dr. Falk has prepared should provide a means to correct this deficiency. It will render her work more reliable, interesting and intelligent. While the book is primarily for nurses it contains much which will be of value to the house staff and even to the operating surgeon.

To Dr. Pool's remarks might be added the statement that the young medical graduate can peruse and digest the content of this book and find in it a great deal that will help to make that trying introduction to the "Operating Room" much less of an ordeal than it generally is.

There are two main divisions of the subject matter in the volume. The first part deals with the preparation of the accessories used in and about the operating room; the second considers the specific preparation of the operating room for the various operations, most commonly performed in the scope of a general surgical service. The

technique of both the preliminary, and the operative procedures is given step by step. Most of the methods described are those in use at the French Hospital in New York City.

In the presentation of the subject matter, the aim has been to make the book a practical one. Occasional repetition has been necessary in the effort to present each operation in a complete form. An endeavor has also been made to cover the subject in simple and direct style. To the text, a number of excellent line illustrations have been added. A dictionary of operating room terms is very conveniently added at the close of the book.

Printing, arrangement and binding are of high quality.

IVOR GRIFFITH.

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VERLAG THEODOR STEINKOPFF, Dresden, publisher of Pharmaceutical, chemical and technical works and also of the "Pharmazeutische Zentralhalle," the scientific weekly journal founded by Dr. Hermann Hager, submits the following two books for review:

DIE AUFFINDUNG DER GIFTE. Von Dr. Wilh. Autenrieth, Professor an der Universität Freiburg. 5. Auflage. Octavo. 628 pp.

The author is a recognized authority on this subject throughout the world. The book is now in its fifth edition, proving that it is one of the most popular works of this kind! The immense mass of material in the new edition can be seen from the following chapter headings: I, Detection of Volatile Poisons; II, Non-Volatile Poisons Soluble in Acidified Alcohol; III, Metallic Poisons; Detection of Those Poisons Outside of Above Three Groups; V, Apparatus and Special Methods; VI, Alkaloidal Assay of Drugs and Preparations; VII, Appendix Containing the Detection of Blood Stains, Reagents, Theory of Anesthesia and The Constitution of Several Alkaloids.

The fifty-four excellent illustrations help to elucidate the text. What a fund of information, authentic material the work contains may be realized from the Subject Index which occupies nine double-column pages.

Authenrieth as an authentic work is to be highly commented and also recommended!

PHYSIKALISCHE CHEMIE II TEIL. Von Dr. Alfred Benrath. Octavo. 192 pp. Mk. 8.50.

Just off the press is Part II of The Physical Chemistry of the well known author, now professor at the Technical High School in Aachen (Aix-la-Chapelle). Part I of the book has been reviewed on a former occasion. The work is Vol. XIV of the Natural Science Series, in which the wide-awake publisher collects all the new data since the beginning of the World War.

As a guaranty of the thoroughness of the book, I might point out three factors: The numerous bibliographic footnotes, as many as twenty-two on one page; an author's index of ten double-column pages and a subject index of six double-column pages.

The book is a distinct contribution to physical chemistry and its newer developments.

OTTO RAUBENHEIMER, Ph. M.

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JAHRESBERICHT DER PHARMAZIE HERAUSGEGEBEN VOM DEUTSCHEN APOTHEKERVEREIN. Bearbeitet von Dr. Heinrich Beckurts, Geh. Medizinabat und Professor an der Techn. Hochschule in Braunschweig unter Mitwirkung von Apotheker F. Dietze in Bad Harzburg. 58. Jahrgang. Bericht über 1923. Octavo, 451 pp. 20 Mk. Vandenhoeck und Rupprecht, Göttingen, 1925.

In 1841 the first Year Book of Pharmacy was published under the title "Jahresbericht über die Fortschritte der Pharmazie und Pharmakologie." The editors were two pharmacists and teachers, Apotheker Johann Heinrich Dierbach (1788-1853), Professor of Botany and Pharmacology at the University Heidelberg, and Apotheker Theodor Wilhelm Christian Martius (1763-1863), Professor of Pharmacy and Pharmacognosy at the University Erlangen. Since 1844 Apotheker Siebert und Martius, and since 1851, Scherer, Wiggers and the world-renowned pharmacologist Theodor **Husemann,** compiled the work. In 1866 the shorter and more suitable title "Jahresbericht der Pharmazie" was adopted. Since 1884 this work has been compiled by an authority and research worker in the field of pharmacy, namely Dr. Heinrich Beckurts, Professor at the Technical High School in Braunschweig. Beginning his career as a practical pharmacist, he became actively engaged in literary work, editing the "Repertorium des Pharmazie of the *Apotheker-Zeitung*, Berlin, and, together with the lately deceased Prof. Ernst Schmidt, of Mar-

burg, the "Archiv der Pharmazie." On August 23, 1925, Prof. Beckurts celebrated his seventieth birthday. May the "Altmeister der Pharmazie" be spared for many years to come and remain active for the benefit of our profession!

Since 1891 the "Jahresbericht der Pharmazie" became the property of the Deutscher Apotheker-Verein. It remains an everlasting credit to our beloved profession that at least three different pharmaceutical associations in the different countries publish such masterworks. Besides the *Jahresbericht,* there is the *Year Book of Pharmacy,* published by the British Pharmaceutical Conference since 1871, and the *A. Ph. A. Year Book,* published by the American Pharmaceutical Association since 1912, the successor of the *Report on the Progress of Pharmacy,* originated by the late Professor Proctor, in 1857.

The arrangement of the *Jahresbericht* is as follows: Pharmacognosy, Pharmaceutical Chemistry, Galenicals, Medical Chemistry, Foods and last Toxicology. Pharmaceutical, chemical and medical journals are abstracted, including THE AMERICAN JOURNAL OF PHARMACY.

Part V of the work on "Chemistry of Foods" is also reprinted as a separate book under the title "Jahresbericht über die Untersuchung der Nahrungs- und Genussmittel," at the very reasonable price of 8 Mk.

Two indices conclude the *Jahresbericht,* a subject index and an author's index. In the latter we find the names of the following research workers connected with the Philadelphia College of Pharmacy and Science: E. F. Cook, Henry Kraemer, H. Leffmann, F. X. Moerk, B. L. and J. C., De G. Peacock, P. S. Pittinger, Fr. B. Power, A. Viehoever, H. C. Wood, Jr., and Chas. H. La Wall (the latter's name being listed under W.).

The *Jahresbericht der Pharmazie* is a library by itself! The book, or still better a complete set of books, should be included in every pharmaceutical library which wishes to be complete!

OTTO RAUBENHEIMER, Ph. M.

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A. HARTLEBEN'S VERLAG, Wien, I., publish a chemical-technical library of handy volumes in duodecimo, which now contains 369 numbers and is being steadily increased. The following three volumes are submitted for review:

*Medizinische Spezialitäten.* Von Dr. pharm. Max Schürer (Waldheim). 5. Auflage. 220 pp. 72 cents.

The name Waldheim has an international reputation in pharmacy. It was the present author's father who compiled an International Pharmacopœia for the Congress of Pharmacy. The book before us is now in its fifth edition, which speaks for its increasing demand and usefulness. It contains specialties, patented articles, secret remedies and nostrums from all parts of the world, used in pharmacy and medicine. That the United States are not forgotten can be seen by the inclusion of Benzyl Benzoate and Cornutal Mulford. The book is arranged alphabetically and contains the composition, uses and manufacturers of the different specialties. It is very useful, especially for the retail pharmacist.

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*Fette, Oele und Wachsarten.* Von Friedrich Thalmann. 4. Auflage. 392 pp. 72 cents.

A very complete subject on fats, oils and waxes. From the 24 chapters let me print out a few: Occurrence, Characteristics, Classification, Manufacture, Animal and Vegetable Oils and Waxes, Uses, Chemistry and Analysis. Twelve years have elapsed since the last edition was published and the present, new edition has been brought up to date. It is a book full of reliable information on oils, fats and waxes!

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*Grundbegriffe der Modernen Chemie.* Von Dr. Wächter. 160 pp. 54 cents.

This is one of the latest volumes of Hartleben's Chemical-Technical Library, being No. 369. The book treats the fundamental principles of modern physics and chemistry such as Elements, Isotopes, Atoms and Molecules, the Rutherford-Bohr Atom, Values, Affinity, Heat, Light, Electricity, etc. These are all explained in plain language, which should help to make the book very popular. A bibliography and author's index increase the value of the treatise.

OTTO RAUBENHEIMER, Ph. M.